This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

LELAND·STANFORD·JVNIOR·VNIVERSITY

ANNEX

ANNEX

6182

THE MONIST

A QUARTERLY MAGAZINE

DEVOTED TO THE PHILOSOPHY OF SCIENCE

VOLUME XXIII

CHICAGO
THE OPEN COURT PUBLISHING COMPANY
1913

COPYRIGHT BY
THE OPEN COURT PUBLISHING CO.
1912-1913

STANFORD LIBRARY

CONTENTS OF VOLUME XXIII.

ARTICLES AND AUTHORS.

PAGE

Agnostic, The (Poem). By C. L. Marsh 586
Andrews, W. S. and H. A. Sayles. Magic Squares Made With Prime Numbers to Have the Lowest Possible Summations 623
Arréat, L. Discussion on Problems of Pure Form 611
Atomistic Dynamism. By Aristides Pratelle 102
Bixby, Dr. J. T. The Spirit in the Wheels: The Mechanism of the Universe as Seen by a Theist 306
Black, G. A. Discussion on Problems of Pure Form 611
Bode, B. H. The Paradoxes of Pragmatism 112
Buddhist Influence on Christianity. By Albert J. Edmunds 600
Buddhist Lore, The Accessibility of, to the Christian Evangelists. By Albert J. Edmunds 517
Carrington, Hereward. Earlier Theories of Gravity 445
Carus, Paul.
English as a Universal Language 603
La Mettrie's View of Man as a Machine 294
The Mechanistic Problem 148
Monism of *The Monist* compared with Professor Haeckel's Monism 435
Montgomery, Dr. Edmund: An Aftermath 462
The Multiplication of Pears and Pence 605
The Principle of Relativity as a Phase in the Development of Science 417
The Problem of Life After Death 596
Problems of Pure Form (Discussion with L. Arréat and G. A. Black) 611
Theonomy (With reference to Dr. Hall's "Scientific Theology") .. 137
Wrong Generalizations in Philosophy (Schopenhauer and Freud).. 150
Chandler, Albert R. Tragic Effect in Sophocles Analyzed According to the Freudian Method 59
Christian Elements in the Bhagavadgita. By Richard Garbe 494
Christian Elements in the Mahabharata, except the Bhagavadgita. By Richard Garbe 321
Christian Evangelists, The Accessibility of Buddhist Lore to the. By Albert J. Edmunds 517
Christianity, Buddhist Influence on. By Albert J. Edmunds 600

PAGE

Clemens, Samuel L. Mark Twain's Philosophy 181
Crooks, Ezra B. Professor James and the Psychology of Religion 122
Current Periodicals 472, 613
Dynamism, Atomistic. By Aristides Pratelle 102
Edmunds, Albert J. The Accessibility of Buddhist Lore to the Christian Evangelists, 517; Buddhist Influence on Christianity, 600.
Fichte's Conception of God. By Ellen Bliss Talbot 42
Focke, Wilhelm Obers. History of Plant Hybrids 396
Freud, Schopenhauer and: Wrong Generalizations in Philosophy. By Paul Carus 150
Freudian Method, Tragic Effect in Sophocles Analyzed According to the. By Albert R. Chandler 59
Garbe, Richard. Christian Elements in the Mahabharata, Excepting the Bhagavadgita, 321; Christian Elements in the Bhagavadgita, 494.
God, Fichte's Conception of . By Ellen Bliss Talbot 42
Gravity, Earlier Theories of. By Hereward Carrington 445
Haeckel's Chapter on Immortality. By C. W. Kendall 595
Haeckel's Monism, Monism of *The Monist* compared with. By Paul Carus 435
Hall, T. Proctor. Scientific Theology 90
Herrmann, Otto. The Monism of the German Monistic League 543
High Comedy of Philosophy, The. By Alfred H. Lloyd 523
History, The Books of Primeval (Poem). By J. W. Powell 422
Hooke, Robert, as a Precursor of Newton. By Philip E. B. Jourdain 353
Hooke, Schopenhauer on Newton and 439
Immortality, Reflections on. By C. W. Kendall 595
Interlingua. By Sydney Waterlow 567
James, Professor, and the Psychology of Religion. By Ezra B. Crooks .. 122
Jourdain, Philip E. B. A Correction and Some Remarks, 145; The Nature and Validity of the Principle of Least Action, 277; Robert Hooke as a Precursor of Newton, 353.
Kendall, C. W. Reflections on Immortality 595
La Mettrie's View of Man as a Machine. By Paul Carus 294
Language, English as a Universal. By Paul Carus 603
Language, "Interlingua" and the Problem of a Universal. By Sydney Waterlow 567
Least Action, Nature and Validity of the Principle of. By Philip E. B. Jourdain 277
Life After Death, The Problem of. By Paul Carus 596
Life, Psychic and Organic. By Ernst Mach 1
Lloyd, Alfred H. The High Comedy of Philosophy 523
Logic, The Philosophical Importance of Mathematical. By Bertrand Russell 481
Mach, Ernst. Psychic and Organic Life 1
Mahabharata, Christian Elements in the. By Richard Garbe 321, 494
Magic Squares and Cubes, Geometric. By Harry A. Sayles 631
Magic Squares Made With Prime Numbers. By W. S. Andrews and H. A. Sayles 623
Mark Twain's Philosophy 181
Marsh, C. L. The Agnostic (Poem) 586

PAGE

Mathematical Logic, The Philosophical Importance of. By Bertrand Russell 481
Mechanics, The New. By Henri Poincaré 385
Mechanistic Problem, The. By Paul Carus 148
Monism of the German Monistic League. By Otto Herrmann 543
Monism of *The Monist* compared with Professor Haeckel's Monism. By Paul Carus 435
Montgomery, Dr. Edmund: An Aftermath. By Paul Carus 462
Multiplication of Pears and Pence, The. By Paul Carus 605
Nature and Validity of the Principle of Least Action, The. By Philip E. B. Jourdain 277
Newton and Hooke, Schopenhauer on 439
Newton, Robert Hooke as a Precursor of. By Philip E. B. Jourdain 353
Newton, The French (Mme. Clémence Royer). By Aristides Pratelle . . 617
Philosophy, The High Comedy of. By Alfred H. Lloyd 523
Philosophy, Wrong Generalizations in. By Paul Carus 150
Plant Hybrids, History of. By Wilhelm Obers Focke 396
Poincaré, Henri. The New Mechanics, 385; The Relativity of Space 161
Poincaré, Henri, on the Relativity of Space 315
Powell, J. W. The Books of Primeval History (Poem) 422
Pragmatism, The Paradoxes of. By B. H. Bode 112
Pratelle, Aristides. Atomistic Dynamism, 102; Discussion by the French Plasmogenists on the Origin of Life, 617; The French Newton (Mme. Clémence Royer), 458.
Problems of Pure Form. By Paul Carus 611
Psychic and Organic Life. By Ernst Mach 1
Psychology of Religion, Professor James and the. By Ezra B. Crooks . . 122
Push? or Pull? Contrasted Views of the Nature Process. By William B. Smith 16
Relativity, The Principle of, as a Phase in the Development of Science. By Paul Carus 417
Relativity of Space, The. By Henri Poincaré 161
Relativity of Space, Henri Poincaré on the 315
Religion, Professor James and the Psychology of. By Ezra B. Crooks . . 122
Royer, Mme. Clémence; The French Newton. By Aristides Pratelle . . . 458
Russell, Bertrand. The Philosophical Importance of Mathematical Logic . 481
Sayles, Harry A. Geometric Magic Squares and Cubes 631
Sayles, Harry A. and W. S. Andrews. Magic Squares Made With Prime Numbers to Have the Lowest Possible Summations 623
Schiller's Philosophical Poetry. By Calvin Thomas 608
Schopenhauer and Freud: Wrong Generalizations in Philosophy. By Paul Carus 150
Schopenhauer on Newton and Hooke 439
Scientific Theology. By T. Proctor Hall 90
Smith, William Benjamin. Push? or Pull? Contrasted Views of the Nature Process 16
Sophocles, Tragic Effect in, Analyzed According to the Freudian Method. By Albert R. Chandler 59
Space, Henri Poincaré on the Relativity of 315

PAGE

Space, The Relativity of. By Henri Poincaré 161
Spirit in the Wheels, The: The Mechanism of the Universe as Seen by a Theist. Dr. J. T. Bixby 306
Talbot, Ellen Bliss. Fichte's Conception of God 42
Theology, Scientific. By T. Proctor Hall 90
Theonomy (With reference to Dr. Hall's "Scientific Theology"). By Paul Carus 137
Thomas, Calvin. Schiller's Philosophical Poetry 608
Tragic Effect in Sophocles Analyzed According to the Freudian Method. By Albert R. Chandler 59
Waterlow, Sydney. "Interlingua" and the Problem of a Universal Language 567

BOOK REVIEWS.

Bluwstein, Dr. J. Die Weltanschauung Roberto Ardigos 159
Derr, E. Z. The Uncaused Being and the Criterion of Truth 319
Huizinga, A. v. C. P. The American Philosophy Pragmatism 159
Isis 477
James, William. Essays in Radical Empiricism 318
Kraft, Viktor. Weltbegriff und Erkenntnisbegriff 160
Levi, Alessandro. La société et l'ordre juridique 160
Loeb, Jacques. The Mechanistic Conception of Life 152
MacDonald, Loren B. Life in the Making 479
MacFarlane, Alexander. Unification and Development of the Principles of the Algebra of Space 318
Mach, Dr. Ernst. Die Mechanik in ihrer Entwicklung 158
Mind 472, 613
Revue de Métaphysique et de Morale 473, 614
Scientia (Rivista di Scienza), ... 474, 615
Siegel, Carl. Geschichte der deutschen Naturphilosophie 480

VOL. XXIII. JANUARY, 1913. NO. 1

THE MONIST

PSYCHIC AND ORGANIC LIFE.[1]

WHEN we place a finger in the hand of a new-born child, he clutches it tightly; if we put a finger in his mouth, he immediately sucks it with might and main. Similar observations may be made of animals, and even—though not quite so easily—of plants; that is to say, various stimulations of the organism produce each a particular reaction, most of the reactions being directed, apparently, towards self-preservation.

If we examine the stimuli that affect our bodies, we notice that in addition to the reactions resulting immediately from stimuli and those intentionally modified by us there is something else which is not discernible objectively but only subjectively, and that is sensation. Our sensations are very rich and manifold. It is very probable that this is also true of creatures with organizations resembling ours; this assumption, however, becomes less and less valid the more the organization in question differs from our own. We can distinguish our sensations one from another, and can remember them.

The orderly, continuous coherence of sensations and memories makes up consciousness. But even our sensations are not always equally clear and distinct, and our sense of their connection with each other is not always equally strong. In sleep, in dreams, in fainting fits, memory and the sense of coherence fail us either partially or

[1] Translated by Margaret Ladd Franklin from the *Oesterreichische Rundschau*, XXIX, 1.

entirely. The farther back into our youth our thoughts penetrate, the less clear our memories become; at length we can discover only occasional islands of remembrance, and finally nothing at all.

We are forced to conclude that what may happen sometimes to us may happen also to other living creatures. Perhaps those that are least like us pass their lives in a kind of sleep or dream or semi-consciousness, so that their psychic life has scarcely any resemblance to our waking condition. For those organisms especially whose existence is maintained by automatic reactions to certain disturbing, injurious stimuli, a more fully developed psychic life is not necessary.[2]

Memory is the reawakening of a previous psychological state. A sufficient condition for this reawakening is the excitation of one element of the earlier state. We are therefore justified in asserting that every part of a given psychological state seeks completion by uniting itself with the whole to which it once belonged. This is the so-called law of association through simultaneity, upon which depends our ability to assign to each memory its proper place in the temporal series. If I see a dish, or a box, and also take hold of it and examine its contents, then the mere sight of it afterwards will remind me of its feeling to the touch, of its contents, and so forth. This may be useful to me in that it may save me the trouble of unnecessary further investigation; or it may deceive me, when, for instance, what I have seen is a mere optical image, which cannot be touched, or a picture, which affords me no further sensations, or very different ones from those I had expected. Cases in which memory is an aid to us we speak of as perceptions; cases in which it deceives us, as illusions. I experience a special kind of illusion when I watch the

[2] Cf. J. von Uexküll, *Umwelt und Innenwelt der Tiere.* Berlin, 1909, Springer.

lights and shadows cast upon old gnarled tree-trunks when the setting sun shines in among the leaves. The heads of bears, tigers, and men come into view, this light or that shadow having the effect of a snout, or a nose, or an ear. One has to guard against illusions such as these—half unconscious, half voluntary—when, at the end of a long and tiresome railway journey, one is looking at the rocks, trees and other objects by the side of the track. Thus it is that in our consciousness sensations unite with the memories they awaken to form many kinds of complexes, some useful, some disadvantageous.

When we compare memories with sensations, we find that the former appear to us dull, pale, imperfect, sketchy, fleeting, in comparison with the latter. But we must consider that sensation furnishes many details to the adequate seizing of which a considerable duration of the stimulus is necessary; on the other hand, the stimulation of memory takes place instantaneously. If we take the pains to observe the separate elements of the sensation, we can also keep them in mind—that is, recall them to memory. This is shown by the fact that particularly simple objects, which we get to know fairly accurately without any trouble, give rise to vivid memories. Think, for instance, of a big black A on a white surface, or of a regular star-pentagram, with one point vertically upward, drawn with green chalk on a black surface. Think of a cube presenting three surfaces to view, the upper horizontal surface yellow, the left-hand vertical surface blue, the right-hand vertical surface red. In such cases, for which one knows the rules, one will have no difficulty in obtaining a fresh, vivid memory. In cases where one has not observed the details of the impression, it is mere tautology to say that one cannot call up a vivid memory. An unpractised person would have a great deal of difficulty in remembering a Moorish ornament complicated in color and in form, such as those in Owen Jones's

Grammar of Ornament. The physicist has no difficulty in remembering exactly a spectrum, or an interference phenomenon, upon which he has been engaged; and a zoologist can draw an animal from memory. If one wishes to picture to oneself a garden arranged for a festival, it helps very much if one thinks of oneself as engaged in the work of preparing it, hanging up the decorations, the Chinese lanterns, etc.

One of my sons, who is a painter, will watch a street scene closely, but will not put it on canvas until he comes home. "In order to see what is typical in the figures," he says, "I must first imprint upon my mind by long-continued observation the regularly recurring characteristics of each figure. While I am in the street I pay attention chiefly to the details, to what is characteristic in the figures, whereas when I am at home I sketch patches rather than figures, in order to obtain the necessary relations of light and shade, and then read into these patches the corresponding figures. The after-image that I get when I close my eyes is often helpful. Figures in a skating scene are particularly easy to retain in this way, because they give a strong after-image. In copying pictures I think I have learned a great deal of technic. By dint of practice I find myself able to copy a painting from memory."

Memories are awakened by sensations, but it may also happen that one memory is aroused by another. The law of association for memories is none other than the above-mentioned law of simultaneity. Memories are awakened originally only through temporal contiguity. But since in the course of a lifetime our memories have come into temporal contiguity in a great multiplicity of ways, they have lost the strong and definite time reference. Memories without express time reference we call concepts. Concepts are the building-stones of the freer intellectual life. Now since concepts have their roots in very different sen-

sation realms, and since corresponding to those sensation realms there are different memories which were separately acquired and may be separately lost—the human memory consists in fact simply of a bundle of separate memories—the result of all this is that the mutual excitation of memories leads man along the ways of biological interest through the most remarkable labyrinthine paths.

Suppose, for instance, I am arranging an experiment in anomalous dispersion; the names of the originators of these studies — Christiansen and Kundt — come into my head. The former I met in London, the latter in Paris. Typical bits of these cities rise up before me. I see the scenes from the Paris electrical exhibit and from the congress of electricians held there in 1881; I see the first electric road, the great dynamo machines, the incandescent illumination, the Jablochkoff lights in the Avenue de l'Opéra; I hear the songs given out by the many Edison phonographs; I make the acquaintance of Wroblewski and am reminded of his sad death; I hear a lecture by Melsen—which suggests experiments with projectiles and brings me back again to my laboratory here in Prague. All this in a few seconds! Of all that my senses experienced in those three months, there are left to me only a few vivid little impressions on eye and ear. A few charming pictures of Paris streets still cling to me. I hear Helmholtz being consistently called "Monsieur Homhotz," while Emil Dubois-Reymond, on the other hand, pronounces German names with a strong French accent.

What is the cause of this poverty of sensations? It lies in the fact that while in Paris I lived more in my mind than in my senses. How do I know that I was in Paris at all? I took a ticket for Paris at the station in Prague, on the assumption that all men mean the same city when they say "Paris." I did not use my senses to find that city. What first-hand knowledge of geography is shown,

on the other hand, by a swallow returning from Africa! After escaping the kitchens of Italy, it finds again not only Vienna but even the old street, and in the street the house with its old nest. I ask for food and drink, for fork, knife, spoon, compasses, ruler, and yardstick on the assumption that others use these words in the same way that I do, and that others react towards these things in the same way that I do. Of course the things must be recognized by more or less definite sensation-marks, but it is not in the least necessary that I myself should thus recognize them. The sense-characteristics of an object may vary more or less without invalidating its name, and they belong to the domain of various different senses. A man's senses are relieved through the help he gets from other men, while his intellect carries a correspondingly heavier burden. The swallow, on the contrary, has to depend entirely on its senses.

G. T. Fechner, in the second volume of his *Psychophysik* (1860), and Francis Galton, in his *Inquiries into Human Faculty* (1883), give accounts of their investigations concerning the power of visualization. The results arrived at by those two investigators are in agreement. In many people—travelers, artists, children, simple men whose occupations require the use of the senses—the power of visualization is great. They can represent to themselves the objects with which they have been engaged, seeing them in all their details and in vivid colors. Those, on the other hand, who are much occupied with abstractions —scholars, for instance, and especially philosophers—have only pallid and indistinct visual images. This is the natural consequence of the habitual inactivity of their senses. I think that for my part I belong in the intermediate class; I have, indeed, kept my visualizing faculty in constant practice, but I readily admit that it has suffered some-

what after all through the attention I have given to abstract things.

The ability voluntarily to summon up clear and accurate memories of sense experiences must be distinguished from the faculty of retaining sense impressions involuntarily and having them reproduce themselves without intention on our part. I have only to busy myself for a while with the vibration curves described by tuning-forks in white on carbon paper, and these curves will flash before me now and then, especially at twilight time, with all the vividness of reality—and always without any exercise of my will. The forms that we observe in this fashion are so closely allied with the things themselves as we have actually seen them, and so different from visual after-images, that Fechner was right in designating them as phenomena of sense memory. When, as a child, I lay down to sleep and shut my eyes, my whole visual area was filled with the most beautiful changing wall-paper patterns—generally flower designs. Even now, when I am a little tired, and shut my eyes, especially on a very sunny afternoon, I at once see a kind of wall-paper pattern, usually greenish yellow on a violet ground. The colors of figure and background often change to their complementaries, as they do in the case of the well-known polarization-figures produced by calcspar when the nicol is turned through a right angle. A short time ago, I saw before me in one of these involuntary observations a yellow-green bough with oak-leaves and acorns, beautifully shaded and molded.

Just before one falls asleep, these apparitions assume a special shape. One sees various human and animal forms, moving slowly, changing their shapes and identities, now vividly colored and now pale, and gradually passing over into real dream pictures. Johannes Müller has called them "*phantastische Gesichtserscheinungen*" which change of their own free will; Maury and other French investigators

call them *"hallucinations hypnagogiques."* They are often quite strange, with nothing about them that seems familiar. But apparently they are really only memory pictures retained mechanically, sometimes even against our will, and coming back to us perhaps out of a distant past.

When I have been torn hither and thither by my thoughts throughout a sleepless night, and then finally, being tired out, succeed in restricting my attention to the visual field, then the slowly changing phantoms appear, and sleep generally follows. Once very late at night, while this change was in progress, there appeared at my left a rich foliage, and at my right, reaching close to the bed, a solid wall of rock which hid everything else from view. This interested me so much, since it reminded me of a scotoma which has sometimes troubled me, and also of a well-known desert hallucination which has been described under the name of "le ragle," that I became wide awake and lost, for a time, all chance of sleep. The slow transformations that the visual phantasms undergo when the attention is concentrated entirely upon them, is due to the absence of associational leaps from one memory-region to another. Occasionally, especially in dark winter nights, my visual phantasms are very colorless: sometimes I see deep black on a black ground, often splendid iron gratings.

Towards the end of a deep, peaceful sleep I see particularly quiet and stable phantasms, and I continue to see them even after I wake up. I wake out of a sleep of this kind and lie still for some time, with my eyes shut. I see my familiar bed-spread with all its folds, and my hands resting upon it. If I open my eyes, I find that it is still quite dark, or else that the folds of the spread, and the position of the spread and of my hands, are quite different from what they were in the phantasms. On one such occasion I see, as I lie awake with eyes closed, an entirely unfamiliar spread, of mottled color—gray, black and white; and it seems to

have high ridges with strong lights and shades, like a little bare granite mountain range. When I open my eyes the phantasm disappears, and I see my usual bed-spread. Another time as I wake up I am looking at a great flower-bed filled with many-colored flowers, like the flower-beds I have often seen in elaborate gardens. The colored phantasms come to me now much more readily if there is a bright morning sun, whereas in my youth this condition was not necessary.

I see a green river slowly gliding between fair meadows. The river changes gradually into a blue-green lake. When I awake the morning sun is shining brightly into the room. The quietness of the morning phantasms seems to be connected with the suppression of all disturbing associations—a condition which we may recognize as we wake up, since we often have to think for a minute before we know, for instance, whether it is morning or evening.

If one dreams that he is wandering through endless halls and cannot find the way out; or that he is vainly searching the house for his hat, or the familiar city for his house, or his street; or that he cannot read a text twice, because the letters are always getting mixed up; or that the money in his purse adds up differently every time he counts it over;—if, in short, there is no logic whatever in one's dreams, this state of things seems largely due to the spontaneous transformation of the dream phantoms—a transformation which is quick or slow according to one's mood.

The associations that take place while one is awake are governed by the same principle as those that take place in dreams, except that more possibilities are generally open to them. A sensation, or even a mere memory, that comes upon us in a waking hour, generally gives rise by association to a series of ideas, which produce in us a particular reaction and determine us to follow a definite line of conduct. A series of images started in this way may, if one

is awake, be prevented by some chance disturbance from running its course; but in a dream this cannot happen. A nervous man who while awake has thrown away a lighted match and neglected to stamp it out, may dream the next night about fighting a conflagration.[3]

A dream experience may also make itself felt very obstinately in a waking hour. Some years ago I dreamed very vividly that a manuscript which I had given to a publisher a long time before had been completely forgotten. When I was awake it took me several hours to persuade myself that the thing was only a dream. Several years later this dream came back to me with all the old vividness. This time, however, I succeeded in tracing the illusion to its probable source in an actual experience. Towards the end of the sixties I had the manuscript of the *Analyse der Empfindungen* in large part finished, and was thinking of dedicating it to Fechner. In a talk I had with him he appeared to be displeased by certain differences between my views and his. I therefore gave up the idea of the dedication to Fechner, and for a long time thought no more about publishing the manuscript at all. Vestiges of my plans, however, may still have lodged in my dreams, and then affected me in the daytime like a menacing psychic disturbance. Thus do waking and dreaming form two interconnected and mutually illuminative parts of the psychic life. But waking and dreaming, and hypnosis, too, in its various forms, all reveal to us only detached parts of the psychic life.

If in the course of a sleepless night I have straightened out part of my next day's work, I am often unable, when sitting at my desk, to recall the thoughts I had in the night. Careful remembrance of my situation and surroundings at the time the thoughts first came to me, will sometimes bring them back to me even at my desk. I am

[3] Cf. W. Robert, *Der Traum*. Hamburg, 1886.

forced to suppose that the existence of an associative relation between different conscious conditions must greatly strengthen one's command over one's own thoughts.

Whole epochs of the psychic life sometimes fall away from us, as is shown in a report made by Prof. A. Forel,[4] in connection with his assistant Dr. Naef. A Mr. N. came, by way of Naples and Genoa, to Zürich, and lived there unconcernedly, without knowing who he really was or to what family he belonged, until he saw a newspaper notice saying that a man whose name was the same as that on his own passport had disappeared, and that his family was making a search for him. Although he could remember nothing whatever, still he now felt that he was psychically diseased, and consulted Professor Forel. By cautious and persevering psychic treatment he was gradually brought to remember a journey to Australia which he had undertaken on an official mission; his memory, which he had lost through an attack of fever, was restored to him; he was given back to his family, and released from his tragic plight.

Only recently people are beginning to observe the phenomena of memory in connection with other organic processes. Ewald Hering has recognized the traits common to organic processes with and without the presence of consciousness, and has described them in his essay on Memory.[5] R. Semon[6] is investigating this relation more thoroughly; and he has adopted a terminology which takes nothing for granted in the way of biological theory.

Many biological processes give the impression that they are based on a mechanical repetition of a lesson that has been learned by heart. P. Huber tells of a certain cater-

[4] Forel, *Der Hypnotismus*, fifth edition, pp. 215-233.

[5] Hering, *Ueber das Gedächtnis als eine allgemeine Funktion der organisierten Materie*, 1870. English translation, *On Memory*, third edition, Chicago, Open Court Publishing Co., 1902.

[6] Semon, *Die Mneme*, 1904; *Die mnemischen Empfindungen*, 1909.

pillar which produces for its metamorphosis a very complicated web. If he took the caterpillar out of a web that had been constructed as far as the sixth stage, and put it into one that had only reached the third stage, then the caterpillar would complete the fourth, fifth and sixth stages. But if it was put into a web that was further advanced than the one it had been removed from, it would begin the work just where it had left off in its last web, not realizing that its labor was superfluous. The robber wasp (*sphex*) digs a hole and then flies out for its prey, which it paralyzes by stinging it in certain definite parts of its body, to serve as food for its progeny. But before taking the quarry into the hole, the wasp creeps in to reconnoiter. Fabre sometimes removed the quarry a little way. The wasp then dragged it close up again, and again crept into the hole which it had just investigated. Fabre was able to repeat this experiment forty times in succession with the same result, whereupon he took the quarry away altogether. The wasp then stupidly closed up the entirely empty hole. Accordingly, it acts, not with reflection, but just as an unmusical player on the piano, who has mechanically learned a piece by heart, must always begin over again from the very beginning if he is interrupted.

Many insects live in the water while they are larvae, but not when they are fully formed. However, they go back to the water to lay their eggs. It seems probable that the physiologico-chemical process of forming eggs in their bodies reminds them of their own embryonic stage and their liking in that condition for the water.

Traits analogous to memory seem to be often evinced in the organic world. The law of association, or completion through temporal contiguity, holds good not only for the fully conscious psychic life, in which it was first observed, but also for dreams, and even for unconscious psychic processes. Is the law of association, however, the

only one that can give us light on the matter? If one wants fully to understand the psychic life through the law of association, one must accept the hypothesis of congenital associations in addition to the associations acquired during the life of the individual. The physiological correlate of the former kind of association would then be reflex action. It appears that we must not merely regard the separate processes of the organism as capable of being excited one by another, but that each partial process must also be assumed to have an independent life of its own. In this way only can we obtain a correct conception of a living organism.

I have shown above how a very exact memory may be called up by means of association. But any one who has experienced the spontaneous appearance of a phantasm, an hallucination characterized by complete sensuous objectivity, will hardly believe that this phenomenon is identical with the former one. In the former case we have the careful completion of a memory through conceptual steps; in the latter we are more often compelled to think, as does Johannes Müller for example, of a peculiar kind of independent existence. It has been found from psychiatric observations that the destruction of both eyes does not incapacitate one for having optical hallucinations, whereas the destruction of a certain portion of the cortex does have this result, and also deprives one of optical memory images.[7]

I have mentioned a scotoma from which I suffered. It began soon after an employee of the laboratory had to be dismissed because of his conduct. It was a flicker-scotoma, of the kind which look like drawings of fortifications. It started in the middle of the visual field, spread itself out over the whole area, and disappeared at the edge. Kant,

[7] See, for example, Forel's *Der Hypnotismus*, Stuttgart, 1907; fifth edition, p. 33.

in one of his minor works, written when he was growing old, has described a similar eye disease. A distinguished oculist was unable to give me any information about this phenomenon, but the psychiatrist Dr. Arnold Pick immediately recognized it as due to a temporary affection of the brain which French doctors have called *migraine opthalmique*. My scotoma recurred from time to time without ascertainable cause, and on each occasion vanished after a few minutes, having no annoying after-effects. It was gray on gray, with an occasional suggestion of faint colors. Sometimes there appeared distorted checker-board patterns. On one occasion I saw a gray-ribbed umbrella with a small hole within which my sight was undisturbed. After an apoplectic attack the scotoma completely disappeared, and it was only many years afterwards that it again showed itself now and then. It will no doubt be admitted that in the scotoma there is manifested a peculiar kind of cortical phenomenon which differs in origin from ordinary sensation and which has no connection with the laws of association.

Johannes Müller has already emphasized the part played by fatigue, hunger and thirst in the production of phantasms, and has thus also given us a better understanding of the hallucinations in which one imagines one is wandering through a desert. The desert hallucinations, which are described by d'Escayrac de Lauture, and later by P. Max Simon in his book *Le monde des rêves*,[8] are common hallucinations, which one may have anywhere, even in bed. Ingenious physiological explanations, based on the structure of the retina and on stereoscopy, are entirely superfluous. Where the Arab sees palms, minarets, and camels, the European traveler sees fir-trees, clock-towers, horses, wagons, and so forth. Marco Polo long ago, in describing the desert of Lob (Gobi; in Chinese

[8] Paris, 1888; second edition, pp. 296-305.

Scha-mo, "sand-sea") spoke of the wicked deceiving spirits that lived therein (hallucinations), who led travelers astray by their voices and caused them to lose their companions. Even in the Bible the desert is full of uncanny things. Isaiah, speaking of the destruction of Babylon, says (xiii. 21):[9] "But wild beasts of the desert shall lie there; and their houses shall be full of doleful creatures and owls shall dwell there, and satyrs shall dance there."

ERNST MACH.

VIENNA, AUSTRIA.

[9] Professor Mach says in comment on this passage that the translation is probably unreliable. The German version translates "ostriches" where our Authorized English Bible has "owls." Friends of Professor Mach explain that the translation "ostrich" is a conventional term for a nondescript bird, that the word "satyr" means in Hebrew shaggy creatures like goats. The Polychrome Bible translates the passage thus:

"Wild cats will lie down there,.....
Their houses will be full of jackals,....
Ostriches will dwell there, satyrs will dance there."

PUSH? OR PULL?[1]

CONTRASTED VIEWS OF THE NATURE PROCESS.

"Yet I doubt not through the ages one increasing purpose runs."
—*Tennyson.*

THE ancient world had seven recognized, almost legalized, wonders. Though some might object to the particular selection, it was generally admitted that whatever they were there could be no more and must be no less than just so many,—for were there not just seven wonders of the sky, the seven wandering stars, and has not Winckler taught us, though Kugler would now unteach it, that in the old-oriental world-conception the history of earth was only a reduced image of the history of the heavens? To-day we have many more wonders than even seven times seven, but still we feel there should be just seven pre-eminent, and men of science are called on to decide by vote which they shall be! An excellent way this, to decide such questions and all others—by vote, provided only you are able to *weigh* the votes instead of merely counting them. Whatever these marvels of modern time may turn out to be, they will surely be marvelous enough, yet it seems that in all ages both ancient and modern by far the greatest wonder is Time itself. A rich and glorious word, far finer than the Dutch *tijd* or the German *Zeit,* or the Latin *tempus* or any of its derivatives, yielding only to the majestic Greek *aiōn* or *chronos*; far nobler than Space, which sounds thin and empty in comparison with the resonant

[1] Address before the Beta Chapter of the Phi Beta Kappa Society, University of Virginia, June 12, 1912.

German *Raum*. Pronounce infinite Space! how faint and feeble by the side of eternal Time! It is not alone however in the fulness of its diphthongal sound that Time surpasses Space, but far more in its inexplorable mystery, in its unfathomable depth of meaning. Space stands always before us, almost visible, solid, continuous, immeasurable, indestructible, immutable, everywhere the same. But Time seems at once more immovable than the firmament and more fickle than the wind, more fluctuant than the wave; more evanescent than the lightning flash, and yet more permanent than existence itself—the quintessence of contradiction, the apex, the node of all propositions, wherein all the threads of affirmation intersect and deny one another. Space has indeed its three dimensions, its triple infinity of determinations, its up and down, its right and left, its fore and aft, but it seems to have these everywhere exactly alike. Time has them not. It stretches itself out in one straight tract backwards and forwards interminably, but at once everywhere and nowhere alike. Down the long line unending rushes the momentary, the tremendous specter of the Present, the eternal visionary Now, shining with intolerable splendor, while far behind lies the dark, the dread, the desert pathway of the Past, which has been and is not nor ever more shall be, and before it the still darker more mysterious pathway of the non-existent Future, which is not nor has been, waiting to flash up momentarily into being and then sink back instantly into the opening sepulcher of the perpetual Past.

It is this deep-seated contradiction, this sense-bewildering, thought-confounding flight of the everlasting, the instantaneous Now, that has moved the German poet to his wonderful verses:

> "Threefold is the step of Time:
> Lingering comes the Future drawn toward us,
> Arrow-swift is flown the Present,
> In stillness everlasting stands the Past."

How much of time is ever existent? The Past has been, but is not; the Future is not, but will be; only the infinitely thin Present is. Like the whirling sword of flame wherewith the Eddystone lighthouse, that guardian cherub of the deep, cleaves in sunder the whole sphere of darkness that envelops it, so the gleaming vision of the Now cleaves with its film of unwearied radiance the solid blackness of the Future and the Past.

In all ages this majestic march of Time, this more than archangel flight of the Alone to the Alone, has bowed in reverential wonder the soul that dared to gaze upon it, and the soul has taken refuge from the fearful vision in the idea of the changeless God. "O Lord," exclaims the Psalmist, "Thou hast been our asylum from age unto age. Before the mountains were born or ever had been brought forth the earth and the world, even from everlasting unto everlasting, Thou art God. Thou turnest man unto dust and sayest, Return ye children of the earth-born. For a thousand years are in thy sight but as yesterday, so swiftly flown, and as a watch in the night." But man the thinker, the son of science, has not been content with the awful spectacle of the flitting Present; he has constructed for himself the solemn procession of the moveless Past and has called it history. Gone though it is like the lightning-flash, he still clasps it in imagination, like Ixion embracing the cloud for Hera. Yea, more, he has endowed it with invincible vitality. He has filled it in his fancy with all the seeds of both Present and Future. Even the natural man, the man innocent of all science, does this in large measure. He relates the Present to the Past not only in the order of before and after, not only in the relation of antecedent and consequent, but also in the far deeper mode of cause and effect. He says that the Past has made the Present what it is, that some subtle invisible linkage has bound together into one all the vision that is with all the visions that have

been. Even the man guiltless of all science, much more of all philosophy, does this, yea, even perhaps the spirit that still slumbers beneath us in the mere animal nor has mounted manward through the spires of form.

It is then the law of man's nature, perhaps the law of all nature, to vivify this lifeless Yesterday and to set it in vital determinative relation with To-day. The dead Past is indeed conceived by us as sempiternally living on in the Present, as making the Present what it is, with iron and inexorable necessity. Such is the prevailing scientific conception of fate, of destiny, more terrible than ever inspired the choral chant of an Æschylus or Sophocles. We call it Determinism, or, as Vito Volterra might prefer to say, mechanical heredity. The modern mind plays with this terrific conception as a child might play with a thousand horse-power dynamo or disport itself in the engine-room of the super-dreadnaught Thunderer. In comparatively few souls is the reaction at all appropriate to the imperial majesty of the idea itself. That the living breathing Present should thus lie grasped in the ghastly death's-hand of the Past is a conception that should be awesome and overpowering to whoever regards it directly, face to face. Yet such is its weird sublimity that the greatest minds of the world have rejoiced in it beyond measure and have proclaimed it with a genuine transport of enthusiasm. Nay, they have not been content to pronounce this absolute lordship of the Past over the Present, but they have stretched out its scepter over all the Future.

In a remarkable and oft-quoted passage, the famous wizard of the heavens, Pierre Simon Laplace, intoxicated with the prowess of his invincible analysis as perfected by his mighty compeer Lagrange, the two forming the most prodigious logical engine the earth had ever seen,

> "Two coursers of ethereal race
> With necks in thunder clothed and long resounding pace,"

that bore the car of mathematics in triumph through the conquered skies, Laplace, I say, has rightly declared that a sufficiently powerful human intellect armed with differential equations and an absolutely exhaustive knowledge of the physical universe at any stage of its being, could thence deduce its necessary and certain condition for any and all future times, or that knowing one moment completely he would know or at least be able to find out all the history of the interminable ages to come. Such an intelligence has been called a Laplacian intelligence, and it is not strange that man should pride himself on the creation or at least the possession of such stupendous powers of prophecy, of which he does indeed make brilliant use in forecasting eclipses and other phenomena exactly, to the second. Similarly, he vaunts that he could predict the exact spot, the exact speed, direction, and acceleration of each and every molecule now in our bodies, not for a day or week or year, but for all the æons of everlasting Time.

If we turn from astronomy to biology, we find there sole-reigning a concept of kindred grandeur and terror, the concept of heredity. The biologist, in particular the geneticist, beholds in each individual the highly complicate but perfectly definite knotting together of a countless number of strands of inheritance, fine, delicate, but infrangible filaments, compared with which the ultimate filaments of a spider's line are thicker than cable cords, out of which is woven without seam from top to bottom the infinite web of plant and animal history, "the garment of life that the Deity wears." These endlessly fine strands stretch back, unbroken, in rigid continuity through all generations, here and there coalescing in pairs, to knot themselves together into a new individual, whence however the same filaments emerge to be knotted together into still other combinations, and so on forever. As the shuttle flies back and forth in the whirring loom of time, the web

of life, the garment of the Godhead, grows and grows without ceasing, but the strands of heredity, the filaments of inheritance, remain the warp and woof in that universal loom. You are what you are because your parents were what they were, and they because theirs were what they were, and so on backward forever, yea, so on forward till the crack o' doom. Thus the Past, the remotest Past, reaches out its skeletal fingers and grapples both Present and Future in its grip of death. I repeat, such is the tragic grandeur of this conception that it has fascinated and enthralled the mightiest intellects, who gaze upon it as upon the visage of Medusa and are turned to stone.

When now we ask how we know that all this is true, that To-day and To-morrow are thus despotically dominated by Yesterday, that some single push from behind has propagated itself like an ether wave through all the world and determined all that is or has been or will be, the answer seems at first utterly inadequate. Express it in high-sounding phrase as you will, talk about Time as an *a priori* form of our sensibility, about the necessity and universality and objective validity of the category of causality—all these resounding vocables tell us finally but very little. The fact is, they mean that it is all only a way of thinking, which is indeed a part of our inmost nature and being, but still is after all a way of thinking, of self-interpretation of the spirit to itself, of constructing and imaging to itself its own experience. When the billiard ball A strikes the billiard ball B, the latter moves, and we say that the impact made it move, that it would not have moved but for that impact, that the momentum of A has passed over into B, that A's motion was the cause of B's. Nor is there any objection to such expressions. It is good that they are not objectionable, it would be very sad if they were; for they are the best we have, and there is no likelihood of any change or improvement. But when we ask how we know that A's

movement caused B's, we are dumb. We can perceive no causal nexus, no interlocking of the two events. So far as we can observe they simply follow one the other. We can never go back and undo the event and find out what would have happened if A had not struck B. "Now of deeds done," saith Pindar, "whether they be good or ill, not even Time, the father of all, can make undone the accomplishment." The most, the best, the last that we can know, is that the one event followed the other in this case, and similarly in all hitherto observed cases, and we may believe ever so confidently and unshakably that such a relation will always hold good. But the causal tie we shall never perceive, we shall never know that there is any at all. So much at least the great Scotchman has done for philosophy, for it is the unique merit of Hume to have perceived, first of men, the true state of case clearly.

We may, then, or we may not go on speaking of cause and effect and of the Past as determining the Future. In mechanics the notion of cause as agent has been surrendered. In a passage that has become classic, Kirchhoff declared even as long ago as 1877 that mechanics is the science of motion, its problem being to *describe* the motions of nature completely and in the simplest way. You observe that there is no reference here to cause or to effect or even to *force*. The motions in nature from the rush of a planet to the vibrations of a molecule, are to be *described* completely and simply, as a dance of atoms, where the motions and evolutions of each dancer are highly complicate and intricate and definitely related to those of every other, yet each carries on its own dance, and naught is said of one's affecting another. It is not a waltz, they do not even touch hands. But in ordinary work-a-day life we may still use most profitably the old forms of speech, even as in law, where half the time of instruction is given to explaining the new meanings of old terms. Nevertheless, it is a great

gain to perceive that these are after all only forms of speech corresponding to settled ways of thinking and not rendering adequately any inherent nature or quality of the happenings themselves. It is a great gain and a great relief to know that the despotism of the Past is after all only our own way of thinking about events, of ordering the totality of soul-experience serially, of smoothing out the infinite flexures of the crumpled rosette of the spirit into the shining silken ribband of history. Ah! you say, a wonderfully folded strip is must be, that can be smoothed out thus interminably. Yes, wonderful! indeed, unimaginably but not unthinkably wonderful. For the famous curve of Weierstrass, the exactest of all mathematicians, is crinkled in precisely this way; between any two of its points the length of the curve is infinite; if you clip out over so small a section and stretch it out, smoothing out the crinkles, you may smooth it out to infinity. We need not, then, stumble here.

It is very rare that a deep philosophic dogma may be distinctly visualized and made indeed palpable to the sense. But such is our strange good fortune in the case of the doctrine in hand, that the causal nexus does not lie between cause and effect in the realm of observed events, but lies if anywhere far back in the determination of the mind, which is depicting its own experience on the broad deep canvas of Space and Time. We all know about living pictures, and the few whose bank balances will allow it, are prone to while away an hour beholding the moving spectacle. All the most complicated events of life both real and imaginary are there represented with a vividness to which there is theoretically no limit. But surely no one dreams that any event there enacted stands in any causal relation with any other. There you may see the ball A strike upon the ball B, and see this latter speed away, but you know that the motion of the one had naught to do with

the motion of the other. If through some defect in the film the whole motion of A had dropt out, the other ball B would have moved precisely as it actually did. The whole system of motions, antecedents and consequents, exists beforehand simultaneously in the film, which itself is a construct of human intelligence imitating itself in this amazingly simple contrivance, which yet produces such multiform results. Very nearly so, to set forth great things by small, is the panorama of the world in Space and Time—a vast vision of the mind's own experience, a moving picture in which all the elements seem riveted together by adamantine nails of cause and effect, but nay, not so! The connections are not between the pictures but lie far behind in the film of our own souls, in the simultaneous psychic experience of the individual, of the race, of the whole creation of spirits that constitute the republic of heaven, the city of the living God.

So much for the tyranny of the Past, over Present and Future. It is a shadowy unreal scepter that is stretched out from that universal mausoleum of vanished ages. But you will say, "Well, after all, things do actually happen in fixed determinate order; the dance of the seasons is never in changed or inverted succession; still the circling hours speed on as ever, Spring clasps the hand of Summer, not of Autumn, and Winter, the old reprobate, still lingers in the lap of Spring. The unvaried orders of sequence and coexistence, which we call laws of nature, do still obtain as a matter of fact, and woe unto him who denies or defies them. What then is the difference, since all things take place *as if* the causal knots were there, whether they be really there or no? Is it not like asking whether the planet that the astronomers call Saturn be really Saturn or not?" Great indeed is the magic of the little words *as if*.[2] Un-

[2] There has recently appeared an imposing work, by Vaihinger, on *Die Philosophie des Als Ob.*

Of course, neither the phrase nor the idea is by any means new. As early

doubtedly the orderly process of nature is just what has been asserted, and well indeed for us that so it is, for otherwise the universe would be naught but an immeasurable madhouse, an asylum of the insane. But the *meaning* of the order is to be sought and found not in the visible infrangible structure of a material universe, lying out there beyond all consciousness, beyond the utmost reach of the soul, in iron strength, in rocklike rigidity, more insensible to the voice of spirit then the granite mountain to the cry of the wind, which was and is and will be when all life shall be swallowed up in the crash of worlds, in the star-dust of primeval chaos returned,—nay, not there! The meaning of the order, yea, the intelligible order itself is to be sought and found all and only in the constitution of the mind, in the nature of the soul, in the self-chosen forms of the activity of Spirit itself. If then the pace of the stars is steady, if the earth spins softly, uniformly on her unwearied axis,

> "Day's Eden brightness still relieving
> The awful night's intense profound,"

it is not because atoms are attracting each other according to the Newtonian law of gravitation, but because they are moving *as if* they obeyed that law; because both they and their regular motions are the mind's own projections of its own activities, and because those activities themselves are not at random but are inherently self-articulated, are implicated in a divine and eternal Order, whose everlasting *image* is the history of the universe in space and time.

Now, I maintain, it is no light or unimportant matter

as 1881, in a public lecture, printed in the *Quarterly Review of the M. E. Church, South* (April 1884), both the phrase and the idea were used by the present writer, and since then repeatedly and elaborately in various connections. Similarly and independently Dr. Carus has amplified the same notion in the same terms in his *Foundations of Mathematics* (1908, see page 79), in an article "The Soul in Science and Religion" in *The Monist*, 1906 (especially pages 250-252) and elsewhere, as is noted in his review in the September *Open Court* of Vaihinger's work, which itself dates back in large measure a full generation. The connection with pragmatism, as originally conceived and formulated by Charles Sanders Peirce, is obvious and important.

that the soul should understand and appreciate this state of case, that it should realize its supreme lordship over nature and nature's laws, that it should insist upon its indefectible title to the magistracy of the whole material world. We could not, we would not abrogate the laws of nature, the principles of gravitation, or chemical affinity, or surface tension, or even of natural selection. But why? Because they lie outside, beyond, and above our poor frail human nature? Nay, but because they lie within our nature, deep in the unexplored, unconscious, and universal depths, sunk far below the utmost plummet of *individual* experience. "When I gaze upon the heavens, the work of thy fingers, the moon and the stars, which thou hast ordained, What is man that thou art mindful of him, and the son of man that thou visitest him?" The Psalmist was right; he does not mean what an insignificant creature, but what a wonderful being is man, whom even Jehovah visits and crowns with glory and honor. The spectacle of the heavens has been thought to bow and humble the over-proud earth-born into dust by showing him his littleness and impotence; nay, but it should rather exalt and magnify the soul of man, who beholds therein his own wonderful creation. He who peers into the silent depths of the sky is really gazing into the mirror of the fathomless abysses of his own being. He who distinctly realizes this will not be terrified by any calamity that can overtake this image, neither by death nor by any other disaster; yea, though the heavens themselves should depart as a scroll when it is rolled together, his soul will remain a stranger to fear, for he will look for a new heaven and a new earth, not made with hands, the workmanship of universal Spirit.

No man that has once climbed this Pisgah peak and beheld the kingdom of the soul and its glory will ever surrender it. Well do I remember how in early years many

times I repeated to myself the stately lines of the elder Darwin:

"Star after star from heaven's bright arch shall rush,
Suns sink on suns and systems systems crush,
Headlong, extinct to one dark center fall,
And night and death and chaos mingle all.
Till o'er the wreck, emerging from the storm,
Immortal Nature lifts her changeful form,
Mounts from his funeral pyre on wings of flame,
And soars and shines, another and the same."

The grandeur of the verses would awe and melt even as it still awes and melts my soul. But never could I repress a feeling of intense dissatisfaction. What! Can this be all? What possible even least worth or meaning or self-justification can there be in a course of history that is born from chaos and dies in chaos, to be re-born from chaos again? Of what avail for Nature to mount from her funeral pyre and soar and shine in everlasting cycle, if only to sink back again in night and death, like a succession of aimless rockets shot up into the empty dark? What possible interest can any intelligence feel in a Nature that does nothing but "cast up from her dark abyss unceasing transformations of herself," without purpose and without aim?

But some one will say this is merely an esthetic, not a rational or logical, consideration. The fact is, he will urge, precisely as stated. Nature does precisely this thing, neither more nor less, and that is the end of it. Whether puny man be satisfied with this procedure of Nature, makes no difference; she is utterly devoid of feeling and cares not a straw for all the men in the world. *Sauve qui peut* is her motto. Such is "natural selection," the "survival of the fittest," where there is absolutely no standard or evidence of fitness but the fact of survival. This survivor is one of the fittest. How do you know? Because he has survived; therefore he must have been fitter than those who did not survive. Whether his superior fitness consisted in strength or in

cunning, in great size or in small, in speed or in sloth, in bright colors or in dull, makes no difference whatever. Nature has no end, no aim, no purpose in view. The initial push given in the primal curdling ether has passed on down the expanding ages, it strikes the Present from the bosom of the Past, like the bolt of Bellerophon launched from the chill bosom of the desert air; it determines all the Future with the mathematical necessity of the successive terms in arithmetic or geometric or other more complicate series, and propagates itself on forever, irresistible as lightning, unfeeling as stone, and blind as the blackness of midnight.

This appalling conception of history is the unavoidable consequence of any and every theory that accepts the outward universe at its face-value, as an ultimate reality, that thinks the world under the category of causality, that seeks to understand the Present and the Future as a necessary consequence of the Past. The whole doctrine is in the last degree logical, it has achieved great triumphs in the annals of thought, and it may very profitably be entertained as merely provisional, as a directive or working hypothesis, as an outward sensual symbolism of an inward spiritual truth. But as the truth itself, as the final word in world-interpretation, no matter by what high-placed prophets it may be preached, we must reject it utterly, not only as false, but also as an abomination. For we have just seen that there is no ground at all for supposing any such causal activity in the world of sense; any real action of one atom upon another, whether together or apart, remains forever unthinkable as well as unobservable. Moreover, a blind process of nature would be always unintelligible, and for several reasons. Even if we make the very minimum of assumption and try to deduce all the laws or habits of nature from mere chance, as simple grooves worn out in the loam of history by the ever-rolling wheel of events, still we must

assume the properties of numbers and the laws of chance, we must assume some medium, some vehicle of events, and must endow it with some definite properties, otherwise it remains unavailable for thought. By no analysis can we ever get out of these assumptions more than we put into them, and any additional property, any new synthetic judgment, will be merely a new assumption.

We cannot then start Nature out totally blind, acting perfectly at random, otherwise she could never select at all, having no principle of selection. Even in her most elementary processes there must be some choice, some preference for this rather than that. Otherwise why should Newton's gravitation take place according to inverse squares rather than inverse cubes? If you explain this by some still more elementary action, as of extra-mundane corpuscles or of ethereal vortex-atoms, the difficulty will be deferred but not removed, the obstacle will be rolled back but not away; for like questions will still be in place. Why do the corpuscles move in right lines? Whence the vortices in the ether? In short, there cannot arise a definite world, a world that is this and not that, except through difference and the recognition of difference somewhere in the generative process. But a blind Nature or nature-process could not recognize any difference,—this indeed is what we mean by her being blind. She cannot then be wholly blind, but must see ahead. A choice cannot refer to what has been or is, but only to what shall be. By the fittest we do not mean the fittest for the Past but for the Future; if not fittest for the Future, it will not survive. We may see then that the conception of a blind or aimless nature-process is not ultimately realizable in thought. It is exactly as if one should postulate an original impulse or push that had no particular direction at all. Such a push of equal intensity in every direction would annul itself and reduce to absolute zero.

But it is not only on such broad and abstract ground that we affirm the necessity of the notion of aim or direction in the conception of the nature-process. When we appeal to human experience, *the final and supreme court of cassation,* we find that no reasoning being reposes on anything else in thinking the conduct of reasoning beings. Anaxagoras had the high honor of being the first to declare that Mind ruled the world. But he was unable, of course, to apply his great idea consistently towards the explanation of the course of nature and so had to fall back upon the conceits of his illustrious predecessors, the Greek philosophers of nature. For this inadequacy he is sharply rebuked by Socrates in the Phædo. Logically and philosophically Socrates was right, but we should do Anaxagoras a great wrong to judge him by a system of notions of which he was ignorant, that had not been formulated at that early date. Without any refinement of terms we may state exactly enough the difference between the two conceptions. Let any one ask himself why he is present at a certain lecture. If he gives the answer in terms of the Past, in terms of push, in terms of matter or of mass and motion, all of which expressions are equivalent, then he has no choice. Let him begin the statement where he may, at 7 o'clock or 6 or 5 or 4, or a day or a month or a year or a millennium in the past, it is all one; he must describe himself and all his antecedents as pieces of machinery, in fact as automata, in which each state of motion has followed with iron rigor and necessity upon the preceding; he must say that the molecular whirlwind called his brain determined certain quiverings of his efferent nerves, and that these quivers fell upon certain muscles and determined certain contractions and relaxations and consequent motions that finally landed him upon the chair occupied. Such is the present word, such must be the last word, of physical science, and it is a most excellent one, eagerly demanded,

and quite indispensable to any perfect and final explanation. But every one perceives that such a statement, such a deduction of the Present from the Past, however accurate, is and always has been and always will be in all generations incurably lopsided and inadequate. For it states at most and at best only the concatenated antecedents, the material *causes* of the man's presence there; it says not one word about the *grounds* or *reasons* therefor. It answers perfectly the question *how,* but it is absolutely dumb with regard to the weightier question *why?* Now it is precisely this question *why* that every man puts and must put, and no man can be satisfied till it is answered. Moreover, it is a matter of immediate knowledge, as primary as primary can be, that no possible assignment of causes, of antecedent conditions, can ever satisfy the questioner, who is seeking for reasons and not causes. Still further, observe that the only satisfying answer will be in terms of the Future, and not of the Past. The man will say, "I desired to hear and see something or somebody." At each instant the desire was a present experience, but the thing desired was and remains from first to last in the Future. At the start he desired to hear the beginning, then he was eager to hear the middle, and finally became impatient to hear the end. When he heard that, he straightway heaved a sigh of relief and hastened home. Once and always his desire is still ahead and beckons him on from instant to instant. It is a voice crying out forever from the bosom of the flying hours. It is the call of the time to come. It is a tug from before, not a thrust from behind; it is the pull of the Future, not the push of the Past. Furthermore, whenever such a reason is assigned, every intelligence recognizes it not only as adequate but as final and incapable of reduction to simpler terms, as an ultimate fact of history. If there is any fault to find, it will be not with the reason but with the man for being drawn on by the reason: it may be said, perhaps, that

he allowed himself to be deceived, that the address was not worth hearing; but it will never be said that the desire, however ill-tutored, was not fully equal to its task, otherwise the man would not have gone.

Moreover it is absolutely inconceivable that any other desire but just that one, namely, the desire to be there at that time, whether to hear or perhaps to see some one else, should have drawn any one thither. This exact precision is very noteworthy. Still further, the desire must have been intense and strong enough, but it may have been a thousand times intenser and yet the result exactly the same. In the well-known song, if the Arab lover had come from the desert on a camel instead of a horse, his desire would have been the same though his speed would have been less. Entirely different is it in the material world, where there exists an exact quantitative equivalence between cause and effect. A small bullet may indeed kill a man as dead as a large one, but not with the same mangling. Here then in the world of reasons we find no place for the fundamental principles of the world of cause and effect. Here too we find finally but one Reason in a million forms and a thousand degrees. It is Will, Desire, Wish, Want, Appetite, Craving, Yearning, Impulse, Instinct, Life-urge, or what you will. All these terms are drawn from our own conscious experience and designate aspects or expressions of the one fundamental element, expressions immensely higher, more refined, and more elaborate than is this one uniform element in its unconscious manifestations—as if we should attempt to express the mental operations of a new-born babe in terms of the logistic of Peano. Since we may never hope to find in human speech a really appropriate name for this ground-element, for it lies far below the reach of earthly tongues, it might be well to employ some purely arbitrary and symbolic term, as Alpha. Or if you think the Greek Alpha and the Hebrew Aleph are rather overworked, you

might choose the Syriac equivalent Olaf. In this case the rose by any other name will smell as odorless.

However you call it, this Alpha has the one eternal and immutable distinction, that it faces always the Future, intent upon a goal that is often unseen but lies always ahead, that it never looks back upon the Past, but presses forever on. So far as we can see, the Past has for it no existence whatever. It may indeed sound strange thus to speak of the Future as solely determining the Present, since we are so used to speak of the Past as the sole-determiner. And yet such is the unique form of inner experience. Peer as deeply and as fixedly as you will into the abysses of your own being, you shall always find therein that it is all and only the Future that determines and in a way creates the Present. At every instant the Past crumbles into nothingness under our feet and we flee from it as from a levee sinking into the Mississippi, while the eternal Future, like the eternal Feminine, draws us upward and on. Not merely, mark you, the immediate Future; in higher and higher consciousness, yea, even in sub-conscious depths the voice cries out from the wilderness of the far-beyond; the endless stretches of the ages-to-come catch up the call and plead with impassioned eloquence; the broad opening vistas of time-to-be resound with the hopes and fears, the aspirations and aversions of the race of man, of the heart of existence itself, and these, yea, these alone it is that guide the bird of history through all her far-homing flight.

We may say then that it is To-morrow and not Yesterday that makes To-day what it is. In itself it is no more and no less plausible that the Future than that the Past should determine the Present; but the undeniable fact is that the determinant is the Future and not the Past. The Future and the Past appear as two aspects of the timeless Now, which stands related to them much as an algebraic expression stands related to its endless trains of integrals

and derivatives. If you have given an algebraic expression, as the square root of z, you shall find it Janus-faced, looking two opposite ways, and you may ask what are its derivatives and what its integrals, the answer being an indeterminate series of each. To take a simpler example, and at the same time to get another view of the matter, if you have given any set of numbers or symbols as 2, 3, 5 and are asked to combine them according to fixed rules, as by multiplication, the operation is called direct, the result is just one thing, namely, 30. But if you have given this result 30, and are called upon to determine whence it came by multiplication, the answer is again definite but is not unique. It might be 2, 3, 5 or 2, —3 and —5, or —2, 3, —5, or —2, —3, 5. In general the inverse operation has a multiple result, where the direct has a single result. We all know that the equation of second degree has two roots, while that of third degree has three, and so on. The problem of solving such an equation is an indirect or inverse problem. Similarly the universal Alpha or Reason is in each case single, whereas the Cause in the Past might be any one of many. Likewise the problem of the Past is such an inverse problem, as for instance to trace back the history of the moon and to find when and where the earth and the moon were one and how they parted company and became more and more estranged, the problem to which Geo. H. Darwin and later T. J. J. See have consecrated so much patience and labor and insight, and with such widely discrepant results. But the problem of the Future is direct and its answer is unique. Only *one* total aspect of creation will be presented to-morrow at noon; whatever it may be, the total aspect will be unique. No two equally justified forms of the same event will or can present themselves, like the two roots of a quadratic equation.

Here then are the wide world-views contrasted. On the side of matter, of cause and effect, the universe is one

immeasurable Memory. On the side of mind, of purpose and aim, it is one unbounded Hope. According now as the accent falls on the one or the other of these, we have this or that system of philosophy, and temper of culture and type of civilization. During the marvelous nineteenth century, the emphasis fell with a heavy and heavier stroke upon the Past. The key-note of this wondrous orchestration was given by Goethe in his deep-thoughted oracle: "The question for natural science is not what use have oxen for their horns, but how did they come by them?" Here all reference to the future is ruled out decisively; the forward gaze of mind is denied all recognition, the category of purpose is struck out of our thinking. The only question is one of cause and effect; the Laplacian intelligence builds up backward, backward forever, and forward interminably, but notice wherewith it builds. Only with the ashes of extinct volcanoes. Never at any point can it insert purpose or aim or meaning into its sublime construction; never can it even raise, much less answer, the question, *Why?* There was in fact no why, no reason for aught in this endless history. When under its all-conquering analysis a far-off temporary halting-place is reached, what then do we find? Naught but one all-embracing incompressible frictionless or perhaps subfrictional ether, curdling here and there into atoms or electrons. I leave out, of course, the more recent theories of relativity and of quanta, which no way impair the foregoing statements.

And now when this same Laplacian intellect attempts to construct a Future, what can it, what must it create? Only an inverted replica of the Past, wherein there neither is nor ever can be any purpose or aim or meaning, even unto the ages' end. On, on eternally the atoms, the electrons, the quanta whirl like a dumb dance of insensate demons, but at no point is there a vestige of any *value,*

at no point is the pull of the Future admitted, everything is deduced with mathematical rigor from the aboriginal push of the Past. And what becomes of consciousness, of the psychical in all its forms, with all its concomitants and derivatives of pain and pleasure, of desire and will, of instinct and reason, of thought and feeling, of good and bad, of right and wrong? Of everything in fact that has any meaning or value in the life of the world? Ah well! This consciousness is to be sure a little puzzling. Since it can never be explained as a phenomenon nor stated in terms of mass and motion, suppose we call it an epiphenomenon and let it go at that. In any case it does not amount to much, it does not last long; with all its kith and kin it is only a sporadic phosphorescent gleam in the infinite dark of time on the silent-rolling surge of matter, such as the voyager admires at midnight while his keel is furrowing the equatorial ocean. What if the earth should have been and continue to be inhabited by this intruding conscious or even subconscious soul for 40,000,000 of years? That need not disturb the serenity of the materialist who reflects that 100,000,000 of years are not even a drop of the bucket in comparison with the dead wastes of endless ages that stretch unvexed of any soul before and after. Rejoicing in these boundless Saharas he may tolerate however grudgingly the thin line of the Nile of consciousness and subconsciousness that lies across them.

Uncompromisingly as I reject this whole scheme of naturalism, let me not for a moment be thought as questioning its great significance, or even its complete justification as a partial and provisional interpretation of the course of history. It is only as a final and complete interpretation that we must condemn it totally. The immeasurable moving picture that the soul makes to itself of its own experience and of the Universal-Soul experience in which it shares and which it projects upon the screen of the

Past, must be described and can be described only in terms of mass and motion, or as Hertz would say, in terms of space, time and mass; it must be understood and can be understood only under the category of cause and effect. We bid then the physicist and the biologist God-speed in their high emprise, even though they confound our intelligence with their new concepts and swamp our language with their new terms. But we should remember and never forget that it is a picture they are dealing with, a shadow of the psychic realities, and not the perfect essence thereof. Let them study and explore ever so profoundly the laws of nature, but let us never fail to keep in mind that the laws of nature are the thoughts of mind, that they are universal and objectively valid only because the nature and therewith the thought of mind remain in broad outline the same for all men, for all the living, who differ from one to another much as two consecutive curves of the same family, enveloped by the same curve; as two circles that intersect each other with centers only just apart.

Bearing this in mind we hail with pride and joy every new conquest of science, every new concept or theory that serves to set in more perfect order the wondrous picture called the world of sense, whether it be Darwinism or Mendelism, whether vitalism or mechanism, whether electrons or quanta or the relativity of time and space. Yea, we shall behold unperturbed the removal of all things that can be shaken, well knowing that the things unshakable still remain. Moreover we shall perceive clearly that it is a false antagonism between the causative and the teleological conceptions of the universe. Willingly we surrender the world of matter to the despotism of the Past, to the tyranny of causality, to the blind predestination of the primal Push. For we know that this world is only a kinematographic representation of the eternal life of the spirit, the only ultimate reality. Willingly we admit that there is

no end nor aim nor purpose in the blinding storm of the atomic world, for we know that the Kingdom of Ends is within us. It is in the conscious and no less in the unconscious life of the soul that we find the Future sole-reigning, that we behold unveiled the face of the everlasting Striving, that we feel the pull of the increasing purpose of the universe.

From this point of view we shall be able to solve many antinomies, to reach out the hand of sympathy and friendship to warring champions of opposing doctrines. In the initial number of the new scientific quarterly, *Bedrock,* we find a powerful plea for Darwinian natural selection as against the *élan vital,* the life-urge of the Bergsonian theory. The author, Professor Poulton of Cambridge University, attempts to test the two views by two crucial examples, especially by that of the mimetic colors of insects, of which he has made a profound and exhaustive study. He reaches the conclusion that the facts in the case can be understood only in terms of natural selection, of the survival of the fittest, of the successful propagation of certain insects that by some purely accidental spontaneous variation in the markings of their wings secured a more protective coloration than their less fortunate fellows.

Now it is no intent of mine to take up any glove in defense of M. Bergson, who certainly has enough eager disciples of his own, whom we all admire even though undazzled by the sudden outburst of splendor in his halo. But I wish to note that Poulton's argumentation, even if accepted at its face-value, glances harmlessly by the position we have sought to make clear. We have no interest whatever in denying the agency of natural selection either in this case or in many others, where it seems to have been more certainly active. In fact it would appear that such selection could work far more effectively on the finite mutations of De Vries than on the infinitesimal variations of

Darwin. One thing, however, is certain. Though natural selection may and even must play a large part in the *survival* of the fittest, it can play no part at all in the *arrival* of the fittest. Even Poulton must speak of "spontaneous variation." It is not necessary to press the sense of the word "spontaneous." Let us grant that it is used only in lack of some better word, that Poulton does not mean that the organism willed or desired or even tended to vary, but only that it varied through unknown mechanical causes. Let us take the extremest case and make the largest possible concession, namely, let us think of what you may let me call the universal life-front, the total advancing aspect of life at any moment, as a huge surface, a sphere surface, for example, and as budding or putting forth variations at every point in every direction; and let us suppose some of these struck down, destroyed, but others preserved to form a new life-front with new variations every way at every point, some preserved, some destroyed, and so on without end. We cannot represent more vividly or more favorably this Darwinian doctrine. But does not any one see that the budding or varying every way at every point remains unexplained? That we have merely described the way *in which the process goes on,* but have not even tried to state the nature or reason of the process itself? That we have only stated how A turns into B, and B into C and so on, but have left untouched the questions, *Why* was there any turning at all? *Why* was there any growth? *Why* any inheritance? *Why* any variation? None of these questions are put, hence none of them are answered in the foregoing scheme.

But Poulton may say, they *can not* be answered, they *should not* be put, in any scientific study of the nature process. Granted, as long as that process is conceived and stated in mere terms of mass and motion. Nevertheless the questions are actually put, whether answerable or not; they are in fact insistent. No rational being can escape

putting them except by refusing to think. The fact then that they are not answerable, nay more, the fact that they cannot even be properly put in the system of matter, of mass and motion, is a decisive demonstration that such a system can never be ultimate in human thinking. However excellent the service it may render as a preliminary and preparatory organization of thought, it nevertheless finds no place within itself for the question Why? no place for the concept of reason, of end, of aim, of purpose. But all these are native to the very thought-process itself by which the system is upbuilded. They can not be stamped out of existence, they can not be disregarded; expel them with a pitch-fork, they instantly return. You can no more get rid of them by thinking than you can think away thought itself.

We must then yield them an eternal abiding place. In terms of them we must construct our theory of the universe, in view of them we must direct our life. Since they cannot be found in the objective world of atoms, of electrons, of quanta, of time and space, there remain at the bottom of our system only the immediately perceived or implied inexpugnable verities of our inner psychic or spiritual experience, whether conscious or unconscious. These are the things that cannot be shaken, these are the living stones in the temple of our world-theory. It may be—indeed, it certainly is—incomparably more difficult to construe the universe as a system of reason and purpose than as a system of cause and effect, nevertheless we cannot finally evade the task, and surely it is noble and inspiring beyond measure. Unto this task it is that the twentieth century is invited, and "along the line of limitless desires." It is in fact an awakening to a new and higher form of self-knowledge than Spirit has hitherto attained, a distincter recognition of the Future as the matrix of the Present, a pursuit more conscious than ever before of the flying goal of history. We dare reverse the homely aphorism of Goethe and affirm

that, without abandoning the causal view of the Past, we must turn to the teleological view of the Future, we must seek to understand the total present as a system of living and striving instincts, where instinct itself in Hartmann's phrase "is the (conscious) choice of means towards an end unconsciously chosen." So then it is the end, the aim, that rises before us as guiding star in this twentieth century interpretation of history, yea, we may indeed proclaim, "The Kingdom of Ends is drawn nigh." It is not strange that the vision of the poet should outrun the perception and reasoning of the savant or even the philosopher, nor that we should find all we have been striving here to express already adumbrated in the great Tennysonian quatrain:

> "That God, which ever lives and loves,
> One God, one law, one element,
> And one far-off divine event
> To which the whole creation moves."

WILLIAM BENJAMIN SMITH.
TULANE UNIVERSITY.

FICHTE'S CONCEPTION OF GOD.

IN the year 1799 Johann Gottlieb Fichte, one of the most renowned and best beloved professors in the University of Jena, and in all Germany, resigned the chair of philosophy on account of difficulties which grew out of the charge that his philosophical teachings were atheistic in tendency. The story of Fichte's *Atheismusstreit* is long and involved, and a sad commentary on the unwisdom of the wise. There is little doubt that both parties to the controversy were somewhat lacking in judgment: if either of them had adopted a more conciliatory attitude, the matter might have been settled without the University losing one of its profoundest thinkers and most inspiring teachers, and Fichte's brave spirit might have been spared much suffering.

Our present concern, however, is not to recount the history of this unhappy controversy, but rather to examine, for a little while, that doctrine of Fichte's which some of his contemporaries denounced as atheistic. In order to understand Fichte's idea of God, we must begin by learning something of the way in which he conceives human life. For in spite of the common opinion that his philosophy is highly abstract and has little or nothing to do with the actual thoughts and feelings of every-day men, the truth is that its basal ideas were gained by patient reflection upon the facts of human experience, as Fichte saw these facts. There have been, perhaps, philosophers and

theologians who have believed that you can somehow prove the existence of God by the skilful manipulation of carefully selected concepts. But Fichte was not one of these. On the contrary, he was profoundly convinced that if we are to discover God, we must look for him, not in the fine-spun speculations of philosophers, not in the trenchant arguments of theologians, but in the actual life of men and women. Now the aspect of human life that seems to Fichte the most prominent is that it is always a striving to attain something or other. Man is essentially a being who strives, who has desires, purposes, ambitions, ideals, and who is continually seeking to realize them. But, being a philosopher, Fichte is not content with noting this obvious fact. With that deep-rooted instinct for generalization which makes a scientist or a philosopher out of a mere man, he asks himself whether all these various desires, purposes, and ideals may not be regarded as so many forms of *one* ideal. What is it that in all your striving you are seeking to attain? What is the one all-embracing ideal that you would fain make actual? It is, says Fichte, the ideal of unity.

To some of us it may seem strange to say that all human effort can be regarded as a striving after unity. And it may therefore be worth our while to pause a little in order to consider the matter more carefully. Let us look first at the nature of intellectual endeavor. We shall agree, I think, that in one important sense, at any rate, the search for knowledge is a search for unity. One of the most common descriptions of the aim of science identifies it with the effort to discover an underlying unity in the diversity of phenomena. A mere fact, unrelated to the rest of your experience, is not knowledge, is at best only the crudest beginning of knowledge. Really to know the fact, you must understand its significance; you must see it in its relation to other facts, must bring it into unity with them.

For example, men did not understand the movements of the heavenly bodies until Newton, with his marvelous faculty for divining unity in happenings apparently most unlike, gave to the world the law of gravitation, until, that is, he helped men see that the circling of the planets about the sun and the falling of the apple to the ground exemplify the working of the same force. The magnificent courage that with one leap reached the outermost bounds of space and dared to say that the force of gravitation, which others before Newton had vaguely recognized as prevailing upon the earth, is a universal force, binding together all parts of the cosmos—the courage that dared take this leap won for men so great an extension of knowledge just because it enabled them to unify so many facts of experience.

There is another sense in which we may say that the striving after knowledge is a striving for unity. Fichte tells us that all intellectual endeavor is an effort to bring about a harmony of subject and object, that when you seek to know anything you try to make yourself one with it. Really to know the nature of something other than yourself means to bring yourself into such intimate relations with it that you may almost be said to have become one with it. Furthermore, Fichte says, you try to effect this harmony by subordinating yourself, as it were, to the object.[1] If you would know an object, you must submit yourself to it, must follow its leadings, must sink yourself in it. In putting the matter thus, Fichte is not doing justice to that more active aspect of the knowing process in which we prescribe conditions for nature, in our experiments, and ask leading questions of her. But even here our activity is preliminary to the more submissive attitude that Fichte is describing. In experiment we arrange, indeed, the conditions under which we are to observe; but in the observing itself we must lay outside our preconceived

[1] *Sämmtliche Werke*, Vol. IV, p. 2. Berlin, 1845-1846.

notions of what we are to see, must become for the time a mere seeing, must—in a highly significant sense—lose ourselves in the object.[2]

Thus in at least two senses we may say that the search for knowledge is a search for unity. But the quest of unity is characteristic of other aspects of life besides that of intellectual endeavor. All that we ordinarily call the practical life of man, as Fichte also points out, is dominated by the effort to bring about a harmony of subject and object. In this case, however, he tells us, we achieve the harmony by compelling the object to conform to the subject.[3] Whenever you attempt to secure any practical results in the outside world, what you are really trying to do is to compel that which is not yourself—some external object, some force of nature, the will of another individual—to conform to your will, to become a medium for the realization of your purpose. Now, the purpose that you wish to see accomplished is, for the time being, yourself; and when you try to realize it through any external means whatsoever, you are trying to bring a not-yourself into agreement with yourself, to effect the harmony of subject and object by making the object conform itself to the subject.

Yet again, when we look at the esthetic side of life we see the same striving to realize the ideal of unity. And this is true both of the creation and of the appreciation of works of art. The artist seeks to mould his objective material—words, tone, color, whatever it may be—into the form which shall express his purpose, seeks, that is, to make the

[2] The more active aspect of the knowing process has received much emphasis in recent discussions of the nature of judgment. There is no question of its importance. But the other fact, to which Fichte calls our attention,—the fact that all judgment involves a submission, on our part, to something beyond the will of the individual,—is certainly no less important and is today particularly in need of emphasis. I have discussed the question at some length in my article on "The Philosophy of Fichte in its Relation to Pragmatism" (*Philosophical Review*, Vol. XVI, pp. 488 ff.)

[3] *Loc. cit.*

object conform to the subject. On the other hand, the ideal of the appreciation of art, as distinguished from its creation, is the losing of the subject in the object. The sense of *me* and *not-me* disappears; the soul becomes one with the beautiful object.

Once more, we may say that moral progress is a progress toward deeper unity. All great moral and religious teachers have realized, more or less clearly, that the moral task of the individual is to effect a harmony of the warring impulses of his nature, to weld into one the "two souls" which dwell within his breast. That ruling of the spirit which, the wise man tells us, is a greater achievement than the taking of a city, means nothing other than this unifying of the conflicting tendencies of our nature. Similarly, when we conceive morality, not as a matter of the inner life of the individual, but as a matter of his relations with his fellow-men, we see, again, that progress means the growth of unity. Fichte often calls attention to this aspect of the question. Human progress, as he conceives it, includes, indeed, all the factors that we have mentioned: the unifying of isolated phenomena through the discovery of their underlying principle; the sinking of the subject in the object in esthetic contemplation and in scientific observation; the compelling of the object to conform to the subject in practical achievement and in creative art; and, finally, the unifying of the warring impulses of our nature in the inner moral life. But it also involves the growth of unity within the social organism. The ideal for the race, Fichte tells us, is that "all individuals" shall be "included in the one great unity of the pure spirit."[4] And spite of the selfishness and jealousies that separate man from man, we are coming, slowly but surely, to see that in their deepest nature all men are one, that the individual can find his true life only as a member of the whole.

[4] *Op. cit.*, Vol. I, p. 416.

What Fichte maintains, then, is that human life, in all its important aspects, may be regarded as the striving to realize an ideal of unity. This ideal, as actually conceived by men, has indeed many forms. Oftentimes our conception of it is painfully crude. The capitalist who is so absorbed in carrying out his own magnificent plans that he takes no thought either for the rights or for the needs of others is guided, indeed, by the ideal of unity, but by a very faulty conception of it. He thinks, forsooth, that the self to which the not-self is to be conformed is merely his own little individual self; that it is *his* purposes, *his* plans, *his* ideals, which his life was meant to realize. But he who looks deeper into the meaning of things discovers something quite different. He sees that the self whose realization is demanded is the wider self in which all one's fellows are included. He sees that the ideal unity, which is the true goal of human endeavor, while it has indeed certain individual aspects, has also a universal aspect, an aspect of inclusiveness, that

> "All are needed by each one,
> Nothing is fair or good alone."

We have been a long time in coming to Fichte's conception of God; but we have been coming to it all the while. For this ideal of which we have been talking is the "Unknown God" whom Fichte declares unto us. God is that ideal of unity which, through its many wanderings and errors, humanity is striving to reach. He is the goal—far away and dimly descried—toward which, through all the progress of the ages, the spirit of man has been struggling. The perfect harmony of all individuals with one another, which includes the harmony of each individual with himself, is the ideal that we are all trying to realize; and this ideal is God.

At this point I hear some of my readers saying that it is no wonder that many of Fichte's contemporaries accused

him of atheism. If God is only an idea in our minds, a mere man-created concept, then there *is* no God in the sense in which devout men, through all the ages, have believed and taught. A mere ideal, born of our dissatisfaction with our present estate, is this what Fichte offers us as a substitute for the living God in whom our fathers have trusted? But I have given as yet only a part of the doctrine. Fichte does not for a moment mean that God is simply our ideal. If we are to find God anywhere, we must, indeed, find him in human life; but the God whom we find in human life is something more than a man-made concept. What this something more is, we must now try to see. And first we must ask what is meant by an ideal. In the most common use of the term, an ideal is something which we regard as having value and which we are striving to attain. But it is really more than this. It is something that furnishes us with a standard, by the help of which we may estimate the worth of certain aspects of our life; we determine the value of the various things with which we come into contact, by their relation to our ideals.

Now standards of value may be either relative or absolute. Anything whatever which I regard as having value and which I use in measuring the value of other things is a relative standard. In and of itself it may have no worth; but I believe it to be worthful—or I assign worth to it for purposes of convenience—and use it in estimating the worth of other things. Money is an example of such a relative standard or relative value. In itself it has no worth; but we take it as valuable and measure the value of other things in terms of it. An absolute standard, on the other hand, has intrinsic worth. Whereas a relative value is beautiful or good or true *for us*,— that is for one or more individuals,—an absolute value is, as we say, *really* beautiful or good or true; that is, it has

worth quite apart from the question whether men deem it worthful or not.

Now an ideal, in the ordinary use of the term, implies nothing more than a relative value. My ideal is something which I conceive as excellent, which I strive to attain, and which I use as a standard. It may be no more than this; and if so, it is simply a value *for me*, a relative value. But it is clear that if there be absolute values, my ideal *may* also have an absolute aspect—may be, that is, a reflection, in my individual consciousness, of something that has worth in itself. It may be, for example, that the type of character that I am striving to attain, not only seems to me good, but is really so. Completely good, of course, it will not be. Our ideals are never perfect; hence, the change in them as we progress. But partially, incompletely, my moral ideal may mirror the absolute value. Similarly, the conception which the artist is trying to embody in sensuous material may not merely seem to him beautiful, but may really be beautiful, may be the reflection, in his consciousness, of the absolute beauty.

We may now return to Fichte's conception of God as the ideal toward which humanity is striving. In describing him thus, Fichte does not mean that he is simply an idea of something which men regard as excellent, which they try to attain, and which they use as a standard of evaluation. God is indeed this, but he is something more. For the ideal, in this sense, *may* have only relative value, may be simply that which we regard as worthful. But when Fichte says that God is the ideal, or—to use one of his favorite phrases—"the Idea of the Ego," he means that God is the absolute value, that the goal which humanity is striving to attain is something which has in itself absolute worth. Fichte's God is not a mere idea in man's mind; rather is man's idea of God the reflection, in human consciousness, of the absolute value. But even this is not

all that is included in Fichte's conception. His God is not simply the supreme value toward which the world is striving, the infinitely distant goal of the world-process; he is also the moving force in this process, the indwelling principle through which alone the striving is possible. This is an important point in Fichte's doctrine. He conceives of God as the spiritual principle that is at work in all finite consciousness and is the motive power in all progress. This spiritual principle manifests itself to us in our ideals; every high aspiration that the human heart has cherished is a revelation of it to the consciousness of man. Not only so, but the very existence of man and of the world in which he finds himself is grounded in it. Human beings exist in order that in and through them the Idea of the Ego may become actual. The history of the race is simply the record of this actualization: it is the becoming real of an idea, the embodiment of value in concrete existence. But the idea becomes actual, the value gains embodiment, not because there is an intelligence, other than itself, which conceives it and wills its realization, but because of its own vital power.

It is evident that Fichte's conception of the relation of God to the world is not the ordinary one. According to the popular view, God is regarded as a divine intelligence which has a certain ideal, which wills that this ideal shall be realized, and which directs the course of the world so as to accomplish its purpose. Fichte feels that to conceive of God as first forming a plan and then choosing means to its fulfilment makes of him a limited being, of much the same sort as ourselves, though, of course, wiser, more powerful, and more beneficent. For this conception we are asked to substitute that of an ideal which *realizes itself*, of a power which is working itself out in human history, but which is not to be thought of as a conscious being like ourselves, forming plans and trying to achieve them. God

is not a being who is conscious of the ideal: he *is* the ideal. Only, this ideal is more than an absolute value: it is also the indwelling force in the world-process. It is both the goal toward which the world is progressing and the motive power in the progress.

It has sometimes been suggested that Fichte's conception, save for its metaphysical basis, has its counterpart in Matthew Arnold's "power, not ourselves, which makes for righteousness." This is fairly accurate, except that Fichte might object somewhat to the "not-ourselves" of Matthew Arnold's famous phrase. In a sense, the power that makes for righteousness is not-myself: that is, it is not "myself" regarded as the sum of my petty personal interests. But, Fichte would say, my deeper self, that within me which reaches out after all that is high and beautiful, is, indeed, but a manifestation of this eternal power. "The kingdom of heaven is within you." Or, in Fichte's words, "The idea of the infinite which we are to attain, hovers ever before us and dwells in the innermost depths of our being."[5]

But at this point an objection may be made. Can any one rest satisfied with this conception of God? Can we, even so far as our theoretical interests are concerned, be content to stop here? Can we rightly speak at all of a supreme ideal which is not an ideal for some consciousness? True, the ideal exists at any rate for *our* consciousness; but it is present to our finite apprehension only in part, not in its rich fulness. Must we not, then, posit an all-embracing consciousness, which conceives the ideal in its completeness and wills its realization? Or, to put the same objection in another form, is the conception of a spiritual force which is working itself out in human history, but which is not personal, a tenable one? If the force is not to be thought of as personal and conscious, must we not conceive it on the analogy of material energy?

[5] *Op. cit.*, Vol. I, p. 270.

It must be admitted that Fichte's theory contains grave difficulties, and there is some indication that he was more or less aware of them. But apparently he believed that any other conception of God is open to still more serious objection. The only other one that he discusses is the notion of God as a being quite distinct from the world, who is its creator and ruler. This conception he attacks with vehemence. To think of God as a being distinct from the world, who is trying to realize a certain purpose in the world, is to make of him, says Fichte, an idol, is to fashion him in the image of man. It is to conceive him as subject to all the limitations to which we are subject. And if we refuse to regard God as merely a more powerful man, we cannot attribute to him, Fichte thinks, personality and consciousness. For they imply limitation from without. But in denying that God is conscious Fichte does not mean that we are to conceive him on the analogy of physical force. "It is only with reference to the limitations" implied in the conception, only with reference to the *form,* he says, "that I have denied that God is conscious. As to the *matter*—I am trying to express the inconceivable as well as I can—as to the *matter,* the Deity is pure consciousness; he is intelligence, pure intelligence, spiritual life and activity."[6]

But if the only difficulty is that our ordinary conception of consciousness implies the notion of limitation from without, why may we not solve the problem by saying that God is a higher form of consciousness, which is free from the limitations that are characteristic of human consciousness? Why may we not describe him as an all-inclusive self, as the Absolute Spirit, in whom all human spirits live and have their being? This would be to take the path that many thinkers of the present day have followed. Why does not Fichte meet the difficulty in this way? There are

[6] *Op. cit.,* Vol. V, p. 266. The italics are mine.

some students of his philosophy who believe that he does, at least in his later works, the writings of his so-called "second period." Many who would accept the interpretation that I have given, as representing fairly well the doctrine of the first period, believe that in the second, which directly followed the *Atheismusstreit,* Fichte alters his position and begins to teach the doctrine of the Absolute Spirit. Throughout the writings of this later period, we find references to God's being (*Sein*), as distinguished from his existence (*Dasein*); and from the description that Fichte gives, it is not unnatural to suppose that by the unchanging, timeless *Sein* he means the perfect and unchangeable Absolute Spirit, and by the *Dasein*, the manifestation of this Spirit in the time-process, that is, in the life of men. For lack of space, I cannot enter into the considerations which prevent me from accepting this interpretation.[7] It must suffice me to say that, in my opinion, Fichte uses the terms *Dasein* and *Sein* simply to distinguish between the Idea considered as a force that is progressively realizing itself in human history and this same Idea considered in itself, quite apart from the fact of its realization. In the latter sense, the Idea is regarded simply as the supreme value; and values—as distinguished from their embodiment in actual existence—are timeless, changeless, perfect. Hence Fichte tells us that time and change belong only to God's *Dasein,* not to his *Sein.*

This, it seems to me, is the way in which Fichte's philosophy should be understood. But it must be admitted that the task of interpretation is by no means easy and that there is room for difference of opinion. And even if one is convinced, as I am, that Fichte did not teach the doctrine of the Absolute Spirit, one cannot say with certainty what

[7] The reader who is interested in them is referred to my monograph, "The Fundamental Principle of Fichte's Philosophy" (*Cornell Studies in Philosophy,* No. 7). See especially pp. 73-80; 83-88; 106-122. New York, The Macmillan Company, 1906.

order] is absolutely necessary, if you presuppose the resolve to obey the law that speaks within you. It is immediately contained in this resolve, is, in fact, the resolve itself."[10]

It is not a part of my purpose to vindicate the theory of the nature of God which Fichte offers us nor to weigh the arguments for and against the various conceptions that our study has suggested. What I have tried to do is to describe the doctrine that Fichte actually held. How we estimate it will depend in large part upon our temperament, our habits of thought, our own intellectual, moral, and spiritual needs. This one thing, however, in justice to Fichte, we ought to say: that whatever objections there may be to his theory, it lends itself to a profoundly religious conception of life. The essential teachings of Fichte's philosophy of religion are that we know certainly and immediately that there is a God; that he is not far from every one of us; that the whole world-history is a revelation of his nature; that every high ideal of which we are conscious is his voice speaking within us; that to be one with him is at the same time our supreme duty and our highest blessedness. Surely, a philosophy that finds the deepest meaning of life in the thought that this little human personality may be—if we will have it so—a vehicle for the self-manifestation of the Divine Idea, is a truly religious philosophy. For the surrender of the self to the domination of the Idea, which speaks within us as our ideal—what is it but that oneness with God, that "life of God in the soul of man" which devout spirits, in all ages, have held to be the essence of religion?

ELLEN BLISS TALBOT.
MOUNT HOLYOKE COLLEGE, South Hadley, Mass.

[10] *Op. cit.*, Vol. V, p. 183.

TRAGIC EFFECT IN SOPHOCLES.[1]

ANALYZED ACCORDING TO THE FREUDIAN METHOD.

THE effect which tragedy produces upon its auditors is too profound and complex to be explained with adequacy by a few formulæ. Its appeal is too many-sided and the aspects of our nature which it brings into play are too obscure and inarticulate. But the inquiring mind will not rest in the presence of mysteries. Every labyrinth is a challenge to exploration. Tragedy in particular is an attractive field of investigation, and we may enter upon our journey with all the better hope of some slight success, because certain modern psychologists seem to have thrown a little light upon our path.

It is characteristic of tragedy to depict a great crisis in the life of a great soul. This is well exemplified in the dramas of Sophocles. His heroes and heroines are cast in a genuinely heroic mould. They are usually members of royal houses and proud of their lineage. They are noble in nature, vigorous in will, violent in passion. They are not required to be morally perfect. Indeed Antigone startles us by her harshness to Ismene, and we can hardly forgive the aged Œdipus for the terrible curse which he lays upon his sons. Such incidents were doubtless not so offensive to the ancient Athenians as they are to us, for their moral ideals involved far less emphasis on pity and charity than

[1] One of the Bowdoin Prizes for essays by graduate students of Harvard University was awarded to this essay in May 1911.

ours. Yet the popularity of Euripides, who was a contemporary of Sophocles's later years, shows that the public was also susceptible to works of a decidedly more humanitarian temper. Other faults, which were certainly reprehensible from the Greek standpoint, were defiance of the authority of the state, scepticism with regard to soothsayers and oracles, and impiety toward the gods. But Sophocles's protagonists, whatever their faults, are never deficient in that energy of will and passion which lifts them above the common level of mankind and gives them a certain grandeur and sublimity.

Characters such as these are brought face to face with some great crisis which often results in the ruin of the protagonist. Suicide, burial alive, blinding followed by exile —these are the events in which some of the dramas culminate. But in the Electra and the Philoctetes the protagonist is saved, not ruined. Most theories of tragedy are concerned chiefly with the former type and perhaps unduly neglect the latter.

The relation of the hero to his doom has been made the subject of profound reflection by many philosophers and critics. It seems to offer inexhaustible material for psychological and metaphysical analysis and for ethical and religious interpretation. I cannot enter into the opinions of later philosophers, but it is desirable to give a brief résumé of the conceptions which the Greeks themselves seem to have embodied in their tragedies.

The Greek tragedies were based on ancient legends. At the time when these legends were taking shape two notions were prominent in the popular consciousness, of which one is the doctrine of the envy of the gods. Disasters which overtake the powerful and prosperous make a vivid impression on the mind. The Greeks felt that the gods must begrudge to man a power and happiness that suggested a comparison with their own. It seemed natural

that the gods should remind man of his mortality and feebleness by bringing disaster upon him. The other notion was the conception of a curse which rested upon a whole family and descended from father to son, begetting fresh crimes and bloodshed in each generation. These notions were embodied in the legends.

As moral ideals were gradually raised the legends were modified so as to give expression to the new ideals. We no longer find prosperity directly incurring the divine displeasure, but prosperity breeding insolence or excess and that in turn incurring disaster. The notion of an ancestral curse is not discarded, but its arbitrariness is mitigated by showing how the evil deeds of one generation provoke the next generation to crime. It is in approximately this form that we find the legends first embodied in the drama. But the art of the dramatists carried the development still further, adding new motives or developing those already latent in the legends. Character is so depicted that the transgression seems to flow naturally from it, and the action so handled that the disaster seems to flow naturally from the transgression. Yet the transgression that incurs disaster must not be such as to alienate the sympathy of the audience. It must be great in order to account for the ruin that follows, and small in order to retain the sympathy of the spectators. This paradox is well solved by the transgression which has a double aspect. It may be slight from the standpoint of the doer, being committed without intent or in ignorance, while it is serious from the standpoint of the observer. Such is the deed of Œdipus, who slays his father in a quarrel on the highway, not knowing who he is. This was subjectively a justifiable retribution for injury, but objectively it was parricide. The development of this solution of the original paradox culminates in the far more profound paradox of the conflict of rights. Thus Antigone stands for a sacred duty to the dead in opposition to Creon

who stands for the inviolable authority of the state. Such a conflict is most poignant when it occurs not between two persons but within the heart of a single person, as when Neoptolemus is drawn in one direction by his loyalty to the cause of the Greeks, and in another by his love of honesty and his pity for Philoctetes.

Such then are the typical materials of tragedy. Let us now see how they are employed by Sophocles.

In the "Œdipus Tyrannus" we find a hero keenly conscious of his sagacity, his strength of will, and his authority. He is intensely a king, endowed with the capacity to rule and glorying in the exercise of his power. He has won his kingdom by his own skill in answering the riddle of the Sphinx and holds it by his ability as a ruler. By the course of the drama the terrible secret of his birth, his parricide, and his incestuous marriage is gradually brought to light. Point by point the proofs accumulate and wring from him an unwilling assent. When at last all is clear, the violence of his passion is such as only a mighty nature can feel. He blinds himself that he may never again see the sights that would recall his glory and his shame, and he is never more sublime than in his desolation.

His own guilt in all this is slight. When the oracle announced that he was to slay his father and marry his mother, it was no sin for him to shun the city of his supposed parents. At the crossroads he was perhaps too easily provoked to vengeance, but he had no intention of parricide. It was surely no sin to free Thebes from the oppression of the Sphinx, to accept the kingdom, and to marry the widowed queen. It was natural that a man who had thus attained prosperity in spite of oracles should pay small respect to them. Such was his career subjectively viewed, but objectively his vengeance at the crossroads was parricide, and his marriage was incest; his wretched fate is the appropriate recompense for those deeds.

In the "Œdipus Coloneus" we find a softer atmosphere. Œdipus has assumed something of the saint, but he is still predominantly the hero. He is still suffering the consequences of the deeds depicted in the former drama. He is a wanderer dependent on scanty alms, but "his afflictions and the weight of years teach him contentment." The gods, moved by his original good intent and his long penance, are about to release him from misery. He is to depart from life, not by any ordinary death, but by a mysterious translation to the other world. He is thus set apart from other mortals as a special object of divine solicitude and invested with a sort of sanctity. The crisis which he meets is the attempt of his sons and Creon to use him for their purposes. The vigor of his resistance and the vindictiveness of the curse which he lays upon his sons reveal a spirit untamed by adversity and unsoftened by the prospect of release. His departure from life is a solemn triumph in his release from suffering, in the blessing his presence is to bring to Athens, in the doom that awaits his persecutors, and in the special favor shown to him by the gods.

Ajax is a supreme embodiment of soldierly qualities as Œdipus is of kingly qualities. His valor leads him to such a pitch of self-confidence that he scorns the aid of the gods. When the Atridæ ignore his pre-eminence in valor by awarding the arms of Achilles to another his unquenchable fury is aroused. He sets out to avenge himself on the Atridae and Ulysses, but a divine power turns his attempted vengeance into mockery. When he awakes to his situation life has no more value to him. He recognizes that the gods are too strong for man to resist, but he will not call them just. He recognizes that the Atridæ must be obeyed, but he summons the Furies to pursue them without respite. He refuses to prolong his life without honor, tenderly makes such provision as he can for the future of his little son, and then betaking himself to a lonely spot

on the seashore he falls upon his sword. His death is no triumph for his enemies, but a release which he himself secures. The Atridæ seek to deprive his body of honorable burial, but the memory of his valor and magnanimity lives so vividly in the heart of his former foe, Ulysses, that that disaster is averted. And with this posthumous victory the drama ends.

In the "Trachiniæ," Deianira is depicted as the devoted wife of Heracles, eager to maintain first place in his affections, and resenting the presence in the same house of his new favorite Iole. She resorts to a charm which she had been assured in ambiguous words would bring it to pass that Heracles "should love no other woman more than her." This charm proves to be a fatal poison, and when she hears the news of its effect she departs without a word and takes her life. Heracles is brought in on a litter to wail out his physical agony before the audience and to curse Deianira. The story of her death convinces him of her innocent intent. He draws a vivid contrast between his former labors and his ignominious end and finally bids his retainers to take him to a mountain top and let him end his misery in fire.

The "Philoctetes" is a complex tragedy, involving three contrasted characters, Philoctetes, Neoptolemus, and Ulysses. The passionate Philoctetes, embittered by years of anguish, is set over against the cold and crafty Ulysses. Between them stands the noble-hearted youth Neoptolemus, to be played upon by both. Ulysses requires all his eloquence to persuade Neoptolemus to get control of Philoctetes by trickery. Neoptolemus reluctantly consents and has carried the design almost to completion when his pity is so aroused by a fit of pain which seizes Philoctetes that he reveals to him Ulysses's purpose to take him to Troy. In spite of his wretched plight Philoctetes cannot be persuaded to consent, but he in turn persuades Neoptolemus

to take him home, in defiance of Ulysses and the other generals. They are about to depart when the deified Heracles intervenes and reconciles Philoctetes to the necessity of going to Troy. The purpose of Ulysses is achieved, but not through his own skill; Neoptolemus has been true to his better self, and Philoctetes's passion for revenge is overruled by the influence of the divinity.

At the opening of the tragedy which bears her name, Electra is living in wretchedness, brooding over the death of her father and yearning for the return of Orestes to avenge it. She defies the authority of her father's murderer and suffers for that defiance. She receives news that she is soon to be buried alive, and then the news that Orestes is dead. She resolves to meet this crisis by slaying Ægisthus, but her project is interrupted by the arrival and recognition of Orestes. Her joy at his return is unbounded, but action is required. Without a trace of compunction she furthers his purpose to kill Clytemnestra, receives the returning Ægisthus with fine irony, and delivers him up to be slain. The drama ends in her complete triumph. Here, as in the "Philoctetes," we see that genuine tragic effect may be produced without involving the ruin of the protagonist. It is enough that a great soul meets a great crisis, whatever the outcome may be.

The "Antigone" is a double tragedy, for although Antigone herself is the center of interest, the transgression and downfall of Creon are also protrayed. Creon has decreed that the body of Polynices shall remain unburied. In defiance of this decree Antigone pays funeral rites to her beloved brother, proclaiming that she obeys a divine law far more worthy of reverence than the command of Creon. He in turn declares that no favor must be shown to the enemy of the state. In spite of the pleading of his son Hæmon, he orders that Antigone be left to perish in a living tomb. Tiresias proclaims the divine displeasure at the

exposure of Polynices. Creon's fears are aroused. He orders the burial of Polynices and the release of Antigone, but it is too late. Antigone has already hanged herself; her lover Hæmon kills himself in her father's sight, and Creon's wife, on hearing of the disaster, takes her own life. Creon confesses and laments his guilt and wanders forth to a life of wretchedness. A conflict of divine and human law is thus depicted. Antigone, the champion of the divine law, goes to a serene and glorious martyrdom, but her opponent Creon is left a pitiable survivor.

* * *

We have now analyzed tragedy into its chief constituents and shown how they are employed in the dramas of Sophocles. But this analysis has done little or nothing to show why we care for tragedy. The dominant elements in tragedy are sin and disaster. Why do we care to see them depicted? In actual life we try to have as little of them as possible. If circumstances force us to witness an actual crime or an actual death we do not wish to repeat the experience; but we have our favorite tragedies which we read and reread, and which we see on the stage as often as opportunity offers. It seems a strange perversion that makes us seek in art what we shun in life.

It is of course true that the mimic woes of tragedy do not produce upon us the same effect as the corresponding actuality would produce. The tragic action takes place in a world of its own, cut off from the world of our practical activity. We know that the actors are not really in agony. We do not rush upon the stage to dry their tears or bind up their wounds. Our attitude is contemplative, not active. Since action is inhibited one might suppose that the sympathies which are the springs of action were also inhibited, but if that were the case tragedy would be a mere spectacle and arouse only such interest as we feel in the gyrations of a mechanical toy. That is not our experience.

The stirring of our sympathies seems to be essential to tragic effect, and we value most the tragedy that stirs them most profoundly.

We have already seen that tragedy may be a vehicle for the expression of profound moral and philosophical convictions and some theorist may seek to explain the appeal of tragedy on this basis. We tolerate the depiction of crime and disaster, he would say, because of the profound truths which are conveyed. But this again seems to be the reverse of our experience. The appeal seems to lie in the events and the characters, not in the lesson; we are lured by the story to listen to the theory, not *vice versa*.

The reason for our love of tragedy evidently does not lie upon the surface of the tragedy itself, nor upon the surface of our consciousness. We must look deeper. There may be forces at work in us of which we ordinarily have no clear consciousness. I believe that there are such forces at work, and that a consideration of them will throw light on our problem. Let us therefore consider at some length a certain theory as to the structure of our mental life. The most recent and most adequate form of this theory is that of Professor Freud of Vienna, whose writings first suggested the reflections upon which this essay is based; but it will be convenient to begin with the earlier and simpler forms of the theory.

Plato in the ninth book of the "Republic" constructs a composite image of the soul.[2] The first component is "a multitudinous, many-headed monster having a ring of heads of all manner of beasts, tame and wild, which he is able to generate and metamorphose at will." The second component is a lion, and the third a man. The fusion of these three constitutes the human soul. To attain righteousness a man must "ever so speak and act as to give the man within him in some way or other the most complete

[2] Steph., 588 C, 589 A B (Jowett's translation).

mastery over the entire human creature. He should watch over the many-headed monster like a good husbandman, fostering and cultivating the gentle qualities and preventing the wild ones from growing: he should be making the lion heart his ally, and in common care of them should be uniting the several parts with one another and with himself." In other passages and in varied metaphors Plato repeats his analysis of the soul into a rational element, a passionate element, and a merely animal element, which strive against one another, but ought to be brought into harmony.

Plato is not alone in noting the presence of conflicting tendencies in our consciousness and conduct. Such conflicts are a salient aspect of human experience and an ever-recurring topic in the writings of moral and religious teachers. Christian thought has dwelt upon the conflict of the flesh and the spirit. Popular psychology tells of head and heart and physical appetites. All of these divisions have a certain value and pertinency, but they do not represent any thoroughgoing analysis. They do not represent all the cleavages that may be found, but only those which have the greatest interest to the moralist.

It is indeed convenient to distinguish one's higher self from one's lower nature, or one's intellectual self from one's emotional self. But we may go further. We may distinguish a professional self from the self that is revealed in contact with one's family, and that again from the self which is preoccupied with some amusement or some hobby. Each of these selves has its appropriate series of ideas, its appropriate group of emotions, its appropriate type of behavior. Carrying this analysis still further we find smaller and smaller units, each consisting of a group of ideas with a characteristic emotional tone and a tendency to produce a particular sort of conduct.

We have now reached Professor Freud's form of the

theory. In his terminology the units above defined are called psychic complexes. Every complex is organized about some core, some central idea or tendency. The idea of Boston, for instance, is the core of a complex including the shops and theaters that one has visited there, the friends who live there, one's admiration or dislike of the city, a tendency to visit it as frequently or as seldom as possible, and many other ideas, and feelings and desires. The instinct to eat is the core of another complex, including the various kinds of food, the places where it may be obtained, the need of money to buy it, and so on. A man's profession is the core of a large and important complex, with a great variety of subcomplexes, involving his mass of technical information, his ambition for the future, and his methods of dealing with his associates and his rivals.

The whole content of a man's mind may thus be divided up into complexes, as a nation is divided up into smaller social groups. The various complexes are analogous to the families, clubs, corporations, professions, and political parties. It may be noted in passing that a given idea may belong to numerous complexes. Dinners for instance not only satisfy hunger, but are an occasion for social intercourse and sometimes for political speeches. The notion of dinner may therefore be a member of several distinct complexes, just as a single person may be the member of a family and also of a church and of a university.

It is obvious that these complexes are not all present in consciousness and expressed in conduct at once. A man devotes a part of the day to his profession, a part to eating, a part to social intercourse, or exercise, or amusement. The ideas, emotions, and modes of behavior which are present in one of these periods differ from those present in the rest. In other words, during each period he is controlled by a single complex, with its subordinate and allied complexes. If we analyzed the course of his experience more minutely

we should find the expressions of a series of complexes concerned with particular problems of his profession, particular friends, particular sources of amusement, and the like.

But the relations among the complexes are not confined to amicable succession in control. There are hostilities among them as there are hostilities among social groups in a nation. Amusement interferes with business, business with amusement, and charity may interfere with both. Morality seeks to organize and unify all these complexes in the interest of the social order and of the individual's highest welfare. In order to do this certain complexes must be enriched and perpetuated and given dominance over conduct; many must be radically modified in order to fit in; and some must be deprived of influence on conduct and banished from consciousness as far as possible.

It is these conflicts which lead to the Platonic simile of the man, the lion, and the beast, and to the Christian conception of a war between the flesh and the spirit. Such conceptions throw the bewildering variety of complexes into a few broad divisions made on moral grounds. But other cleavages and other conflicts are just as real, and the old divisions are therefore inadequate from a scientific standpoint. There are esthetic and prudential conflicts as well as moral conflicts. There is a repression of tendencies to bad taste and foolishness and unconventionality as well as a repression of tendencies to vice. Our waking life as a whole is dominated by a great group of complexes which guide our thoughts and conduct along the lines of conventional morality and taste and prudence. This group of complexes may be said to constitute the upper stratum of the mind; the less favored complexes, the lower stratum.

The process by which one complex prevents another from expressing itself in conduct and even banishes it from consciousness is called suppression. But suppressed complexes are not annihilated. They may continue to invade

consciousness from time to time, or they may influence the course of events in consciousness without actually coming to the surface. The dictates of prudence and kindliness lead us to suppress reference to the faults and misfortunes of those with whom we converse, but anger weakens the force of this censorship, and the angry man says things which he could not bring himself to say in a moment of calmness. Other strong passions as well as anger may weaken the control of the upper stratum; alcohol and other drugs, fatigue, weakness, and pain have a similar effect.

But suppressed complexes may also give evidence of their presence without actually coming into consciousness. Like moles burrowing in the ground, they may disturb the surface without appearing on it. It is on this principle that Professor Freud accounts for a variety of phenomena, including dreams, hysteria, and wit.

This fact that complexes once or repeatedly suppressed are likely to affect consciousness again may be most conveniently expressed by saying that they continue to exist in the subconscious, but any reference to the subconscious is likely to arouse distrust and provoke controversy. Here, however, no specific theory of the subconscious is presupposed. The suppressed complexes may be preserved merely in the form of traces in the nervous system, which may become from time to time the physiological basis of the disturbances above mentioned; or they may be preserved as actual conscious states not accessible to introspection, but constituting a series of processes parallel to those which we find by introspection; or their subconscious survival may be merely a convenient term to denote the virtual existence of something whose only actual existence lies in its occasional effects on introspective consciousness. One of these theories will serve quite as well as another for the present purpose.

The full force of the theory of suppressed complexes

can be seen only in its applications, and of these I can give but a few examples. I shall select examples that seem most likely to have a bearing on the theory of tragic effect. The first of the series of cases that originally led to the formulation of the theory was as follows. A girl was suffering from hysteria. At one time during her illness she became unable to drink. In spite of her thirst she could not bring herself to touch a glass of water. While under hypnosis she happened to relate that a few weeks before this she had seen the governess's dog drink from a glass of water. She had been intensely disgusted at the sight, but had repressed all signs of the emotion out of respect to conventionality. As she narrated the incident she gave energetic expression to her restrained anger. She soon called for a glass of water and drank without trouble. The symptom vanished permanently.

The mechanism of the case seems to be as follows. An incident occurred which combined the feelings of disgust and repugnance with the idea of drinking water. The complex thus formed was firmly repressed by the upper stratum. Its energy was thus deprived of its natural outlet in angry words and gesture, but it tended to escape in some other channel. The line of least resistance lay in making the process of drinking distasteful to the person. The reason for this distaste was prevented from rising into consciousness by the censorship of the complexes of the upper stratum. When the vigilance of the upper stratum was relaxed by hypnosis, the complex found a natural outlet for its energies, and no longer needed to produce an abnormal symptom. Freud has treated many hysteric symptoms on the presupposition that they have a similar origin and may be relieved in a similar way. His method of treatment is to cause the patient to explore his memories. He especially insists that all ideas that tend to arise shall be allowed to run a free course; none must be rejected as unpleasant or

foolish or improper; criticism must be relaxed. In short, the censorship of the upper stratum must be suspended as far as possible, for in that way the suppressed complexes have the best chance to find relief.

Freud calls this treatment the cathartic treatment, thus recalling to us the most famous of all dicta on the function of tragedy, namely Aristotle's statement that tragedy through pity and terror effects a catharsis of these emotions. It is possible that we have here something more than a superficial analogy, but before we consider this possibility let us take up one further application of Freud's theory.

Dreams for the most part seem to have no intelligible connection with the rest of life. Some of them, however, will be found to depict situations which are demanded by suppressed wishes. Erotic dreams are a typical instance of this. This suggests that other dreams may be disguised expressions of suppressed wishes just as the hysterical symptom is a disguised manifestation of suppressed emotion. There is excellent evidence that this is the case. Let a person consider one of his own dreams that does not on the face of it express a wish. Let him analyze it into its components, that is, let him consider each of the persons and incidents depicted one by one. Let him fix his attention on one of these, and allow the associated ideas to flow into consciousness with perfect freedom, suspending as well as he can the critical censorship of the upper stratum. Let him do the same for each of the other components. In the course of this process he will be almost sure to come upon the memory of some wish or tendency that he has suppressed. That idea will come with a certain air of finality, and the investigator will have an instinctive feeling that his search has found its goal.

It seems natural to suppose that the suppressed wishes thus recalled are the sources of the dream. The relaxa-

tion of the censorship of the upper stratum during sleep gives the suppressed complexes an opportunity to disport themselves. But they do not find the censorship entirely suspended. They therefore remain suppressed until they happen to assume the form of some imagery which the censorship will allow to pass. The wishes may therefore appear only in a disguised form, and the more firmly they are suppressed in the waking life, the more complete the disguise which they assume in the dream, because of the resistance they must overcome. The process by which this disguise was effected is retraced step by step in reverse order by the series of associated ideas above noted.

This process may be illustrated in the case of a man who dreamed of an acquaintance who was teaching in the same university with him. The dream-image had the features of an uncle of the dreamer's, though it purported to represent the acquaintance. It was accompanied by the consciousness of a strong affection for this composite person. On tracing out the associated ideas the dreamer recalled that this uncle was rather a blockhead, had sometimes got into trouble with the law, and had never made a success of his life; he also recalled that his acquaintance was his rival for appointment to a certain professorship, but was not extremely brilliant, and that another rival had been involved in a lawsuit in early life. The dream may therefore be regarded as the expression of a wish that his rivals should fail in their candidacy for the professorship. The dream emphasized the points which might militate against his rivals' success and hinted that they would be decisive, but it did this indirectly by identifying the rivals with another person who had analogous shortcomings, and whose shortcomings moreover had proved disastrous. But why was the feeling of affection present in a dream whose motive was hostility? This reversal would seem to be due to the repressing influence of the upper stratum, which

thus as it were avenges itself on the intruding complex. Freud holds that the emotional tone of a dream is very frequently due to the upper stratum, not to the lower.

The difficulty of recognizing dreams as the fulfilment of wishes is now readily explained. It is suppressed wishes that they fulfil. When the dreamer awakes and the upper stratum resumes control, he may sincerely declare that he has no such wish. It is not his dominant self which harbors it, but the submerged self of which he is not even conscious. Moreover the wished-for situation is often disguised beyond recognition, precisely in order to elude the censorship of the upper stratum. The reversal of the emotional tone often makes the situation seem one that is to be feared and shunned rather than wished. Furthermore the wishes expressed are often survivals of early childhood and quite foreign to adult habits. Freud attributes the dreams of falling through the air, or floating horizontally in it, to childhood experiences of being tossed up and caught again, or rapidly carried along—experiences of which children are fond.

We have now discussed the conflicts between complexes. We have shown how the vanquished complexes, although suppressed, still find an outlet for their energies in hysteria and in dreams. Suppressed complexes are also concerned in certain slips of memory, in the production of wit and in its enjoyment, but we shall not attempt to analyze these processes.

There is, however, another type of relation between complexes which deserves our attention. There is not merely conflict between complexes but there is also cooperation, reinforcement, and even coalescence. Professional zeal is reinforced by the desire for financial return. The desire for financial return is itself the resultant of a variety of complexes including desires for food and shelter, for family life, for social position, and the like. A special

and very important case of this is the reinforcement of a complex belonging to the upper stratum by a suppressed complex. When this occurs a double result follows. The suppressed complex has found an outlet for its energies without having to appear in a form offensive to the upper stratum; it need no longer give rise to hysterical symptoms or to dreams; its contribution of energy to the reinforced complex serves as a substitute for these. On the other hand the reinforced complex has more energy at its command, and therefore expresses itself with more vigor and completeness. Such a process may be called the sublimation of the suppressed complex. In a broader sense the term sublimation may be applied to any case in which a complex, whether suppressed or not, is made tributary to a complex of higher esthetic or moral value. Perhaps the most striking instance of sublimation is that of romantic love, in which physical passion is diverted from immediate gratification, and finds vent in emotions of tenderness and adoration, in the production of songs and sonnets, and in the intensification of professional or warlike ambitions.

I have not attempted to establish the truth of Freud's theories, but only to show what they are. I have omitted many aspects of them which are important for the explanation of dreams or hysteria, but which do not seem to be applicable to tragedy. If therefore the account of dreams and hysteria seems inadequate, that should not discredit the theory of complexes. The points of the theory which I have sought to make clear are that the mind contains a variety of psychic complexes, that some of these come to be suppressed, that the complexes dominant in the waking life form a fairly well-defined group which may be called the upper stratum, that suppressed complexes force their way to the surface in disguised forms, and that complexes may be sublimated.

How then is this theory to be applied to the psychology of tragedy? Professor Freud himself has given us some clues. As I have already noted, his term "cathartic treatment" suggests Aristotle's definition of the function of tragedy. It raises the query: "May the tragic catharsis also be the release or sublimation of the suppressed complexes?" Freud carries us a step further by an incidental reference in his book on dreams.[8] He is speaking of those premonitions of erotic passion which begin very early in childhood, but whose presence usually escapes notice. He asserts that the boy's first infatuation is for his mother, and his first jealousy for his father. The influence of such tendencies survives in the special devotion which a son usually shows to his mother, and the strained relations which frequently develop between him and his father. Freud then refers to the "Œdipus Tyrannus" which hinges on precisely this situation. Œdipus has unwittingly yet actually become the murderer of his father and the husband of his mother.

Freud attributes the peculiar poignancy of the horror which we feel at the situation of Œdipus to the fact that in our early and forgotten infancy we had to suppress such tendencies as we here see realized; the upper stratum recognizes an ancient enemy and reacts against it with peculiar force. He does not explicitly offer a theory of tragedy in general. He claims to explain why we are horrified, but does not explain why we are fascinated.

Let us now go a step beyond Freud, but in the direction which his work suggests, and formulate a general theory. *Tragedy attracts us because it depicts situations which our suppressed complexes demand.* The protagonist does what our suppressed complexes would have us do; his action therefore gratifies those complexes. Where the plot of the tragedy centers around transgression and disaster, it is

[8] S. Freud, *Die Traumdeutung*, 3d ed., Leipsic, 1911, 189 ff.

not the disaster to the protagonist which attracts us, but his transgression, and the way in which he bears the disaster. The primary appeal is therefore not to the upper stratum but to the lower. The upper stratum, however, is not idle; it must be placated, or it will force us to turn away from the tragedy in disgust, and thus leave the suppressed complexes unsatisfied. From this psychological standpoint the primary aspect of tragedy is the appeal to suppressed complexes, and its secondary aspect the methods of placating the upper stratum.

The theory above stated is perfectly general in form, but I shall not here attempt to apply it to any other works than those of Sophocles. Let us consider what are the suppressed complexes to which the Sophoclean tragedies appeal, and what devices are employed to placate the upper stratum.

A drama that involves no contest hardly deserves the name of drama, and tragedy especially centers about some struggle in which the protagonist engages. This appeals to an instinct which is very powerful, yet which has to be repressed in civilized communities, namely pugnacity. When a child's wishes are thwarted he becomes angry and fights to the best of his ability. But all sorts of social forces work upon him to suppress such tendencies. He learns to control or at least to conceal his resentments and animosities. When he has reached maturity these tendencies have little opportunity for free play. The upper stratum exercises a rigid censorship on all expressions of anger and hostility, for both prudence and kindliness require self-control.

Tragedy gratifies our pugnacity by showing the fighting spirit in vigorous operation. An instance of this is Œdipus's graphic narrative of the quarrel at the cross-roads, where he, single-handed, slew Laius and his four retainers. The account culminates in the grim phrase

κτείνω δὲ τοὺς ξύμπαντας,

which is thrilling in its effect. It is not merely such bits as this, however, that appeal to our pugnacity, for in many cases the attitude of the protagonist in the whole action is one of defiance. Philoctetes's hatred of the Atridæ is the keynote of the drama that bears his name. One of its most effective passages is that in which Philoctetes, having just recovered from a paroxysm of physical anguish, reasserts his unalterable resolution to remain in misery rather than bow to the will of his enemies. The effect is intensified when the protagonist's hate is directed against some member of his own family. We find hate where we might expect love, and judge its power by the strength of the ties it has broken. This effect is produced by Electra's desire for vengeance upon her mother, and by the curse which the aged Œdipus invokes upon his sons. Hostility to the state and to the gods is especially effective, because the protagonist defies a power so much greater than his own. Our admiration of Antigone is due in part to her magnificent defiance of Creon, and Ajax stirs us by his defiance of the gods.

Closely allied with pugnacity is the tendency to pride, display, and self-assertion. This tendency also shows itself in children, but is repressed. The community demands modesty, and humiliates those who will not learn it. A strong appeal to this tendency is made by the magnificent self-confidence of such heroes as Ajax and Œdipus. Most of Sophocles's protagonists belong to royal houses and are proud of the fact. This pride makes their downfall all the more pitiable, but it also nerves them to endurance, as when the aged Œdipus mentions his own dignity as one of the sources of his resignation.

Another tendency which is universally present and universally subject to some degree of repression is erotic passion. Freud's treatment of this factor in the "Œdipus

Tyrannus" has already been noted. Let me add that I suppose that this factor not only makes the situation horrible to the upper stratum, as Freud remarks, but also makes it attractive to the lower stratum. We admire the tragedy because the fascination which we dimly feel outweighs the horror of which we are clearly conscious.

Freud might well have extended his investigations to the "Electra," which seems to me to be the companion-piece to the "Œdipus." What is true of the boy's relation to his parents is true of the girl's *mutatis mutandis*. The father is the first recipient of her devotion, and the mother her first rival; and in a lesser degree a sister is also a rival. Electra's father has been murdered by her mother and her mother's paramour. She herself is forbidden to marry, lest she raise up children hostile to the murderers, and her natural impulses are thus turned inward to embitter her brooding passion for revenge. What wonder that she hates Clytemnestra, who has not only cut off the object of her devotion, but has shown herself unworthy ever to have been Agamemnon's mate! What wonder that she regards the sacrifice of her sister Iphigenia as a flimsy excuse for such a crime, and that she scorns the weakness of her other sister Chrysothemis! What wonder that she hates Ægisthus who usurps her father's power! What wonder that she rails at the adulterous union of the murderers! Such are the motives which play far beneath the surface, but which contribute much to the power of the drama.

In the "Ajax" and the "Antigone" the erotic motive is not of great importance, for the devotion of Tecmessa to Ajax and of Hæmon to Antigone are only incidental to the chief action. But in the "Trachiniæ" it is the dominant force. It is passion that leads Heracles to capture Iole and send her to Trachis. It is the desire to be first in Heracles's affections which moves Deianira to send the fatal gift.

This tragedy is not so effective as the other Sophoclean tragedies that have survived. The reason is that the underlying motives do not find sufficiently vigorous expression. We know Heracles's passion for Iole only by cold hearsay. Deianira is not moved to any grand revenge or grand renunciation, but meets the crisis with a foolish trick.

Sophocles's dramas have still another source of power, which is found in the laments. The psychology of their effect is a topic on which I cannot speak with confidence, but the situation seems to be this. In actual life the effect of disaster is to depress our vitality and also to evoke an emotional reaction, involving tears, moans, and violent gestures. This emotional expression seems to constitute a sort of revulsion against the situation which occasions the depression. We avoid such situations because of the depression which they occasion, not because of the revulsion—we do not primarily revolt against the revulsion, which would be absurd. There is no way of inhibiting the depression, but the revulsion is suppressed in many cases by pride, by a desire not to alarm others, and by other motives. Now when laments are presented on the stage our vitality is not depressed, for the disaster has not fallen upon us, but our suppressed tendencies to emotional revulsions are gratified, for we see grief expressed with eloquence and abandon. I need only mention the passage which follows the blinding of Œdipus to show how effective a lament may be. Laments are prominent in all the seven tragedies. They are especially powerful where the protagonist summons his pride and his fighting spirit to his aid as do Ajax and Œdipus.

Other suppressed complexes to which tragedy appeals could be mentioned, but pugnacity, pride, erotic passion, and the tendency to lamentation seem to be the most important. These are emphasized in countless ways by the skill of the tragic poet.

One of the most important devices of emphasis is contrast. The most tragic of contrasts is that between the passionate hero and the force which threatens or compasses his ruin. When Œdipus derides the oracles, or Ajax speaks defiantly of the gods, we feel their vitality all the more intensely because we are at the same time reminded of the doom which awaits them. The actual occurrence of the disaster produces a double emphasis. It creates a contrast between the strength of the hero's character and the wretchedness of his plight, and it also tests the hero's character by evoking its whole strength. One reason why the actual occurrence of the disaster in tragedy is preferable to its being threatened and averted is that only so can all the resources of the hero's character be brought into play.

Emphasis on the hero's passion is also secured by the rhetorical art with which the speeches and dialogue are composed. The protagonist is not inarticulate but eloquent. Moreover his emotions find not only a direct expression in his own words and deeds, but an indirect expression through the responsive emotions of the chorus. We see not only the stern resolution of Ajax but the perplexed forebodings and again the false hopes of his sailors; not only the misery of Œdipus but the sympathetic grief of the Thebans.

All these devices for emphasizing the hero's passion commend the drama to the suppressed complexes; but they would make it only the more obnoxious to the upper stratum if no concessions were made to the demands of morality, conventionality, and beauty. Let us therefore turn to those extenuating circumstances and elevating factors in tragedy which make it acceptable to the upper stratum of the mind.

A great variety of factors tend to palliate the evil involved in the transgression which the protagonist in most tragedies commits. Chief among these are the motives

which at least partially justify his act. Ajax, Electra, and Philoctetes have received injuries which tend to justify the violence of their hatred. The presence of Iole justifies Deianira in an attempt to guarantee her own position, though not in the folly of her method. Antigone is moved by love for her brother and by a reverence for the divine laws, while Creon is moved by what he regards as the interests of the state.

Sometimes the situation presents a dilemma such that whichever course the hero may choose will involve disloyalty. Neoptolemus has to choose between loyalty to the Greek leaders and the demands of honesty and pity; Antigone has to choose between respect for human law and respect for divine law. Since in such cases the protagonist cannot avoid evil, he is the more readily forgiven. Thus the upper stratum is placated, and our suppressed pugnacity delights in defiance displayed in a good cause nearly as much as if the cause were evil.

There is a peculiar economy of motive in a tragedy such as the "Antigone," where the transgression of each of the chief characters tends to justify the transgression of the other. The evil is decreased by duplication and our sympathy intensified by division.

Transgression is often condoned because it seems to be the incidental result of an admirable quality. Ajax's impious scorn of divine aid and his excessive resentment of an injury are incidental to that impetuous valor which made him the "bulwark of the Achæans." Œdipus's hasty action at the cross-roads, and his contempt for the seemingly discredited oracle, are due to the qualities of energy, sagacity, and self-reliance that won him a kingdom and enabled him to rule it well.

When the protagonist transgresses unwittingly his act loses none of its horror but becomes pitiable instead of

reprehensible. The parricide and incest of Œdipus, and Deianira's fatal gift to Heracles, are cases of this sort.

In the "Œdipus Tyrannus" the whole course of Œdipus's life is dominated by the mysterious and implacable fate which step by step fulfils the oracle spoken at his birth. He seems to be acting of his own free will and avoiding the disasters of which he is warned. But this semblance of freedom is actual bondage, and this semblance of escape is actual ruin. His transgression indeed flows from his character, but since character and occasion are fatally predetermined the responsibility seems to be lifted from his shoulders.

The Greek tragedies were based on familiar legends, and the audience knew in advance the general course of events. The contemplation of the action was mingled with foreknowledge of the impending disaster. The transgression therefore seemed less heinous because it was known that it would bring pitiable ruin instead of undeserved prosperity.

The transgression is more readily condoned when it is followed by repentance as well as disaster. Creon fully admits his guilt at the close of the "Antigone." Œdipus views his own deeds with the greatest horror when he learns their true nature.

The passionate reproaches which Creon and Œdipus heap upon themselves bring us to the topic of lament. While it is true that transgression is partly palliated by the laments which follow it, lamentation itself needs to be justified to the upper stratum. That justification is found in the extremity of the disaster which is the exciting cause.

Ajax's loss of honor, Philoctetes's physical anguish, Electra's grief for her father, Œdipus's discovery of his own guilt, are situations which justify the most unbridled expressions of grief and anguish. When the person's own

guilt is the occasion of his lament we have a sort of reciprocity in which guilt and lament mutually justify each other.

The disasters which tragedy depicts would be merely shocking, not tragic, if torn from their setting and narrated in the bald phrases of a newspaper item. Disaster must be exalted by receiving some spiritual significance in order to make it acceptable to the upper stratum.

Disaster most frequently appears as retribution. It is the fit punishment for transgression, and the moral sense of the spectator is satisfied. The ruin of Ajax, Œdipus and Heracles is terrible, but not wholly undeserved. Disaster also appears as due to the feebleness and mortality of man, and serves to remind us of these limitations. No human prowess is invincible; no human prosperity is secure against calamity. Such thoughts as these were prominent in the proverbial wisdom of the Greeks. Ulysses in the "Ajax" says:

> "I commiserate him .....
> Seeing in us all, as many as are alive,
> Nothing but phantoms or a fleeting shade."*

Man is not only morally defective but physically weak, and he is hemmed in by natural as well as moral laws. Tragedy throws upon its disasters the light of this general principle; it depicts them as inevitable, and thus leaves no room for protest.

Disaster is ennobled by the nobility with which it is borne. Such is the nobility of Œdipus, who blinds himself to shut out the sights which could only intensify his misery. Antigone faces death with the serenity of a martyr. Ajax seeks death as a release from ignominy. The aged Œdipus is vindicated and transfigured by the mysterious doom which the gods prepare for him.

Besides the factors which specifically tend to palliate

* Young's translation.

the horrors of transgression and of disaster, there are others which ennoble the tragedy as a whole. The legends on which tragedies were based had the glamor of antiquity and commanded almost religious reverence. The very place in which the tragedies were presented was sacred, and the performance was an integral part of a religious festival.

All the arts of diction and music and dancing were lavished on the presentation. The dialogue is in an exalted style, and the imagery is often beautiful.

The choral lyrics express emotions responsive to the progress of the action. But music and dancing soften the emotions they depict: they do not rack us as speech and gesture sometimes do. The choral passages serve as resting places where we relieve ourselves from tension before the inexorable course of the events again hurries us on. Scenes of tenderness have a similar function. Ajax sends for his son, prays that his lot may be more fortunate than his father's, and gives him his shield. Œdipus weeps over his helpless daughters. Deianira shows pity for Iole and the other captives. Scenes like these soften the harshness of the action in which they intervene.

Such then are the primary factors in tragedy, which appeal to the suppressed complexes, and the subsidiary factors, which disarm the hostility of the upper stratum. The structure of tragedy is like the structure of a dream, since its fundamental motives are derived from the lower stratum, and these motives are forced to express themselves in a guise acceptable to the upper stratum. The complexes which produce the dream are often survivals from the experiences of early childhood. So in the case of tragedy, the legends on which it is based have come down from the childhood of the race. And since each individual has to recapitulate the development of the race in his own

development, these ancient legends remain significant to every generation.

Tragedy may also be compared, not to the symptoms of hysteria, but to its cure. In the cathartic treatment of hysteria the purpose is to secure a vigorous emotional expression of the suppressed complex that shall drain off its energy and restore serenity to the mind as a whole. This is precisely what tragedy does for us; it furnishes an emotional outlet for our suppressed complexes. The relief which follows constitutes a sort of catharsis.

But the tragic catharsis is not merely relief; it also has a higher aspect, that of sublimation. Tragedy does not merely release the energy of the suppressed complexes, but turns it into more profitable channels. That is why tragedy gives us a sense of expansion and elevation, and makes us feel that our taste for it is not merely permissible but salutary.

Many of the devices for conciliating the upper stratum consist in appealing to some of its component complexes.

When disaster is depicted as due to moral or natural law, a strong appeal is made to our ethical and philosophical interests. It is vividly impressed upon us that man is mortal and must think thoughts that befit mortality, that revolt against the state brings disastrous results, that the violation of family ties is horrible in the extreme, that oracles are sure to be fulfilled at last, and that the gods must be reverenced. The drama is thus made to teach a lesson, but the lesson is effective only because the play has held the attention and stirred the imagination. When once the dramatist has us under his spell we are receptive to his message, but the spell of tragedy depends on its appeal to our suppressed complexes. It is they that furnish the energy which rivets our attention on the drama, which in turn embodies the message. A channel of discharge is thus established, leading from the suppressed complexes to those

complexes of the upper stratum which center in ethical and philosophical interests. The former are therefore made tributary to the latter. The lower complexes are relieved and the higher are strengthened and stimulated. Discord is replaced by harmony.

This happy result is not due to design. The Greek story-tellers whose imagination built up the legends of the house of Labdacus and the house of Atreus knew nothing of suppressed complexes and were not plotting to conciliate the upper stratum. But the story-teller and his auditors *had* suppressed complexes and upper strata, which guided the imagination of the story-teller and stimulated or restrained the applause of his auditors. There was a process of trial and error in which those stories were sifted out which the people best liked to hear. The dramas which grew out of these legends were developed by essentially the same process. Those plots and those methods of treatment survived which appealed to the Athenian public. Tragedy is a natural growth, not a weapon suddenly devised in the interest of some moral or philosophical propaganda. But having once arisen, it has a theoretical content and a moral effect.

The theoretical content of Sophocles's tragedies has been sufficiently indicated by previous references to his doctrines of human frailty and moral retribution. But it may be well to close with some remarks on the moral effect of tragedy. We saw that catharsis has two aspects, one of release, the other of sublimation. Since the suppressed complexes are potential disturbers of our moral peace it would seem to be a moral gain to discharge their energy into harmless channels. That is doubtless the case unless the complexes are strengthened in the process. There is sometimes an effect analogous to that which exercise has on the muscles. When a person accustomed to exercise is deprived of it for a certain length of time he becomes rest-

less; energy accumulates which demands relief through exercise. But exercise if freely pursued is likely to strengthen the muscles; if it is later discontinued the uneasiness will be all the greater. A regimen of exercise would have to be very delicately balanced in order to relieve all uneasiness without strengthening the muscles. So in the case of suppressed complexes, the processes which release their energy are likely also to enhance it. It would be very difficult to say just how often a person should visit a tragedy in order to give his complexes relief without increasing their future demands.

The situation seems more favorable when sublimation as well as release occurs. A relatively permanent connection is then established which makes the lower complexes tributary to the higher. But even in this case the lower complex may be strengthened, and sublimation is rarely so complete that the lower complex finds an outlet only through the upper one. Romantic love involves an elaborate sublimation of erotic passion, but often fails to secure entire control of its energies. So we may justly fear that the most elevating tragedies will sometimes strengthen the passions they sublimate.

Tragedy is therefore a mixed good, like nearly all the things we cherish. Its effect may sometimes tend toward morality, sometimes away from it. But fortunately its justification does not lie in its value as an instrument of moral education, but in its intrinsic value as a form of art. Morality has more potent instruments at its command, and may be trusted to take care of itself. Tragedy does enough if it lifts us for a brief time above the trivialities of life, and fills our imaginations with its glorious heroes and their mysterious fates.

ALBERT R. CHANDLER.

HARVARD UNIVERSITY, Cambridge, Mass.

SCIENTIFIC THEOLOGY.

[This paper is addressed to those who are dissatisfied with the views commonly set forth of a creator and ruler of the universe; to those who through some acquaintance with modern science find an inconclusiveness in theological reasoning, and to those who have noticed that religious dogmas have lost their hold upon the majority of intelligent men.

On the other hand those who find full satisfaction in a creed and those who have no practical familiarity with scientific induction will find here nothing worth while.

It is to be expected also that some who are unable to follow the reasoning will try to demolish it by attributing to separate phrases or statements meanings not intended by the writer. Life is too short to guard fully against such misunderstandings.—T. P. H.]

ALL men learn by experience. From accumulated experiences philosophers draw conclusions valuable to all. Experience being very common and reasoning rather rare in the early ages of humanity, reasoning was highly esteemed, then over-rated, valued as an end and not as a means to wisdom; and so the extravagant pretensions of philosophers fell later into contempt.

Then Science was born. Conclusions were logically drawn from wide and accurately observed experiences. These conclusions were further tested by application to new sets of facts and corrected as often as found defective. Astrology then gave way to astronomy. The "Black Art" became chemistry. Soothsaying and witchcraft were replaced by psychology.

The old philosophical views depended for their accep-

tance upon the authority of some great name. The greatest and wisest of men, the men nearest to nature's heart, felt and dimly saw the deep realities of the universe. Some of their immediate followers were able to see the same verities when pointed out to them. The others who accepted their views did so on faith, believing in the ability and truthfulness of their leaders who claimed to see what was beyond their own limited powers.

Scientific conclusions do not rest upon authority, but upon facts, the investigation of which is open to every one, and upon inductive reasoning which is worthless if it quails before the most searching criticism. The pursuit of science is the pursuit of truth inductively.

When we say that theology is unscientific, we do not imply that it is false. We mean that its utterances are given under the authority of great names, and acceptance is asked on the basis of authority rather than of facts and logic. The range of facts required for the construction of a scientific theology is so extensive that theology has been compelled to wait for the fuller development of science. Science has now covered the fields of space, matter and energy, and is rapidly including all organic life. That is to say, it is now generally admitted that in these departments the scientific method of investigation is the only one that gives results worth having.

Because of the complexity of their phenomena, religious experiences are among the last to be scientifically studied. It was necessary that scientists should first become familiar with the simpler phenomena of matter and energy before they were capable of understanding the more abstruse and complex. As the investigation of religious phenomena proceeds there will be developed from it the explanation of the facts, which will form the science of religion. A beginning has been made by William James and a few others, but it is not too much to say that at present no such science exists.

Theology, however, is not limited to religion. It attempts the largest generalizations of which we can conceive, and as a branch of philosophy it can become scientific only as an induction from all the classified facts of experience, of which religious experience is only a small part. At present it is therefore possible to give only a rude outline of scientific theology. Its fuller development waits the growth of biology, and especially of the science of religion.

What follows is written from the standpoint of realism. If the reader be accustomed to think in terms of idealism he may find it necessary to change the terminology. But the facts presented and the conclusions drawn are true, whatever view is taken as to the ultimate nature of the things considered.

From the unity of the universe Herbert Spencer drew the conclusion that polytheism is untenable. There cannot be more than one ruler of the universe. This conclusion meets with the approval of all scientists. Whether there is a God at all is a question for further investigation.

Let us first review some fundamental generalizations of science.

Time is something measurable. It enters into many other quantities, such as speed and power. But it is unchangeable, uncreatable and indestructible by any known power. It is as impossible for any of us to march one moment ahead into the future as it is to fall back into the past. We are in the march to stay, as long as we are in the world. Time is for us a cosmic element.

Space is a second cosmic element. It is uncreatable and indestructible. It is like itself only, and cannot be confused with anything else in the universe.

Matter has many forms. For more than a century the elements withstood the efforts of chemists to change them one into another. Nevertheless every scientist has believed

that though the elements are many they are all forms of one "matter," whose properties are described in every text-book of physics. The transformation of the radio-active elements recently discovered are of intense interest, but they add nothing, because nothing could be added, to the belief of the scientist in the essential oneness of matter, of which he sees only the varying forms. Matter, including under this term the ether, is indestructible and uncreatable by any known power. It is a third cosmic element.

One other such element is known to science. *Energy* (as defined in physics) has existence in many convertible forms, as motion, strain, heat, light, sound and electricity. But, though easily transformed, energy is indestructible and uncreatable. That is to say, not the least particle of energy is ever known to be created or destroyed. Energy is a fourth cosmic element.

These four are the only cosmic elements known to physical science. All other things in the visible world are variable in quantity as well as form. These have also the common character of simplicity. The smallest conceivable part of any of them does not differ in kind from any other part of the same element. All other things are complex and can be so divided that some of the parts are essentially unlike other parts.

These four elements and their combinations form the whole physical universe. Outside of them we know only one other class of things, namely, those directly relating to conscious life. In this class we know of no single thing that has the marks of a cosmic element, nothing that remains constant in quantity through all changes of quality and form. But by analogy we may infer that there is to the things of this class a substratum which does remain constant. Let this substratum be named "*Spirit.*" Then the argument for the existence of spirit as a fifth cosmic element is as follows: Five distinct classes of things—time,

space, matter, energy, and the things relating to conscious life—form with their combinations the known universe. The first four of these are each decided by scientists to be permanent in quantity. The fifth class must also be permanent in quantity or else subject to partial annihilation and creation from day to day—an unthinkable condition. If the fifth class is quantitatively permanent it must have under its apparently variable phenomena a common and permanent substratum (here named "spirit") having the characters of a cosmic element.

If this argument seems inconclusive, let it pass. It may be that these cosmic elements are not absolutely permanent. It may be that, just as has been found with some of the elements of matter, there is a slow transformation taking place, one cosmic element changing into another. It may be that spirit is the least constant of the five, and that the evolution of the ages is making spirit a larger and larger element of the universe. It may be that other cosmic elements exist, of which we have not yet the faintest intimation. These are speculations going far beyond our knowledge.

Let us return to things we know. About the ultimate nature of the chemical elements we know a little. The little that we know about the transformation of matter from one element into another does not invalidate any of our previous knowledge of the elements. We continue to call them elements, and we know that they mark a definite stage of aggregation of matter. So also any speculations we may indulge in about the ultimate nature of the cosmic elements cannot alter the fact that they are a very distinct and definite stage in the formation of the universe, and no future discoveries can alter that fact.

If five or more cosmic elements form the universe, there must be some fundamental bond amongst them, something holding them together as a universe, some substratum

common to them all and of which each is a manifestation, just as silver and carbon are two manifestations or forms of matter, and as heat and electricity are two manifestations of energy. To this common substratum let us apply the term "God."

It may be objected that the word "God" is already in use with an entirely different meaning and therefore should not be used here. But if it can be shown that the word as here defined is similar in its essential meaning to the term in common use, the objection falls. The only knowledge we can possibly have of God (using the word in the theological sense) is gleaned from his expression in the universe. But as long as the term is philosophically defined there will continue to be as many gods as there are thinkers to define it. Moreover the use of any term for this substratum, this common bond of the cosmic elements, would suggest to the reader the hypothesis of two gods, one immanent, belonging to the whole universe, the other an outsider, a Royal Mechanic who impresses his will upon the universe. Though the latter view of God is commonly taken by ignorant men, it has not the sanction of the greatest theologians. It would be folly to claim that all the efforts of the ages to find out God have been wasted. Men have blundered and will blunder, but there has been progress. If science has now reached a stage where it has some contribution of value to offer in the search after God, let us accept it and if necessary modify our ideas; but let us not forget what has been already learned, and that we can at best bring only a small contribution to this age-long quest. The God discerned by science is not a new God, but the same Eternal seen from another standpoint and seen in some respects more clearly.

How do we learn the properties of matter? We know matter only in its various forms or manifestations, as iron, wood, coal, rock, water, air, etc. Whatever properties are

present to some degree in every form of matter are properties of matter, such as mass, elasticity, volume. Properties found only in a few forms of matter are not considered fundamental. Magnetism belongs to iron, but not to copper; it is therefore not a property of matter. So also we know energy by finding what properties are common to its various forms. Proceeding in the same way to study the cosmic elements, we may gain a fuller knowledge of their substratum, God. Taking in each cosmic element one prominent character that is also found to some degree in each of the others, and is therefore universal, we may get, in rude outline, the attributes of God. Many others may be added, and every addition to our knowledge of the universe increases the possibilities of our knowledge of God.

From *Time* we get the suggestion that God is eternal; from *Space*, infinite; from *Matter*, that all action is according to regular law; from *Energy*, the principle of evolution; from *Spirit*, intelligence. The God of the universe is thus an eternal, infinite, consistent, evolving, intelligent God. These are attributes to which every scientist must give immediate assent. Careful study will enable him to add many more. Every one is at liberty to investigate and draw his own conclusions, as in every branch of science. The dogmatist is he who draws conclusions without sufficient investigation.

Men's ideas of God have been fragmentary and distorted. According to theologians God is spirit. But this is evidently no more true than the statement of the astronomer that God is infinity, or of the evolutionist that God is power, or of the materialist that God is matter. Each of these statements is an approximation toward truth. Since men are characteristically and essentially spirit, their first clear ideas of God were as spirit. Knowing little of matter, they clothed God with the common attributes of men; described him as irregular, capricious, selfish, vengeful, ty-

rannical; so that Ingersoll was moved to say, "An honest God is the noblest work of man." With the development of natural science came the knowledge of natural law and evolution. Scientists could no longer accept the theologians' ideas of God. By a revulsion of thought many men turned from the theological idea to an equally fragmentary idea based on materialism or on evolution. Caprice cannot coexist with natural law, and absolute and final perfectness is inconsistent with evolution. Gradually it has come to be generally realized that law is universal, and the theological idea of God has been modified accordingly. Evolution as a process in nature is now generally accepted, but it has not yet found a place in the theological system. The idea of an omnipotent and absolutely perfect God cannot be reconciled with the imperfections of the universe as we know it. But an evolving God is in harmony with all the facts we know, and cuts the knot of many an unsolved problem. This idea of evolution as an essential character of God is not easy to grasp fully. It contradicts the common view of God as unchangeable or as the Absolute. The whole known universe is in the march of evolution. Its essence is therefore evolving. Its plan is being formed. Its aims are more clearly defined now than ever before, its consciousness clearer and more extensive. Of a beginning or an end science knows nothing. The process only is seen. We are conscious portions of the universe. God is in us and is through us enlarging the plan and developing its parts. We have no reason to suppose there was ever an original design perfect in all details. The design itself is growing into consciousness in the heart of the universe, just as it grows in the life of an individual.

The problem of evil is recognized and its solution attempted by every known system of theology, from the ancient Egyptian down to the most modern Eddyism. The Zoroastrian doctrine of twin deities—one of them good, the

creator of light and life; and the other evil, the creator of darkness and death—has been partly incorporated into the Miltonian doctrine of a good and powerful God who has already defeated and will ultimately destroy the arch-rebel Satan, the source of all evil. Mrs. Eddy shifts evil into the realm of idealism, explaining it as delusions of mortal mind,—which are to be at last all cleared up. Every theological system recognizes that a contest of some sort is going on, and that evil is being overcome by good. But the origin of the fight, or the necessity for it, is nowhere made clear. If the creator of life cannot overcome his evil twin, or cannot destroy Satan, or cannot prevent "delusions of mortal mind," these causes of evil, he is not omnipotent. If he can but will not, he is not good.

Granting evolution as a fundamental principle in the universe, this conflict takes on a different appearance. Intelligence being also fundamental, there appears before us always ideals, which are the scouts of the evolutionary process. Present conditions are "good" as they make for our ideals, and "bad" when they do not. To a democrat the growth of the trusts was only bad,—his ideal was in the past. To a socialist the same industrial movement appeared good because it pointed toward his ideal of a co-operative future. The general trend of ideals, themselves the product of evolution, is necessarily in harmony with the general trend of evolution, of events, and hence it has come to be an essential part of doctrine in every religion that good will finally conquer. Social conditions that are now universally condemned are called bad because ideals are already picturing out the coming advance into something better. And when these ideals have become realities, higher ideals will take their place, compelling a re-classification of the events and conditions to suit the new ideals. So the forces of the universe mould its materials by means of intelligence into forms of higher organization. And as

the universe evolves, as knowledge becomes broader and truer, as ideals become more cosmic and events follow more closely, more and more of the universe is classed as "good," and stronger and fuller appears the harmony of all.

> "Yet I doubt not through the ages one increasing purpose runs,
> And the thoughts of men are widened with the process of the suns."

As an example of further investigation into the nature of God, let us consider the question whether or not God is love. This is equivalent to the question, Does love or its analogue appear in every part of the universe where such appearance is possible?

Love is not in any sense known to belong to time or space *per se*. Neither is its opposite. Nor can we conceive of either love or hate belonging to what we know of time and space. These two cosmic elements may therefore stand aside from this question. Taking the next element, matter, we find an analogue of love in gravitation, a universal attraction. If there are any atoms that repel each other, they do not belong to the visible universe, for they would ages ago have made their way toward the boundary of the ether, into the outer darkness, hence beyond the possibilities of our knowledge. In all atoms we find also chemical attraction more or less strongly developed. Cases of apparent repulsion are probably apparent only, and are easily explained on other grounds. Coming to the next cosmic element, energy, we find here and there antagonistic forms. For example two opposite electric charges tend to coalesce, disappear as electricity, and become light and heat. With such small and insignificant apparent exceptions, the energy of the universe is harmonious. In the fifth cosmic element, spirit, both love and hate appear. It remains to be seen whether both are real or whether one is merely the relative absence of the other. As a factor in life, love is supreme over hate, else the human race would perish. Every

man loves himself; and does what he thinks right and best for himself—perhaps not by your standards, but by his own. At first, in early childhood, his "self" includes only his own wishes and feelings. Later as he develops it comes to include successively his own body, his possessions, his family, his friends, his clan, his society, his class, his nation, his race, and all life. Everything outside his "self," that threatens to interfere with it, rouses antagonism because of his devotion to his "self." Here love is clearly seen to be the prime moving force, which appears as hate only in certain undeveloped conditions. Hate is then only limitation and negation. By definition, God is the essence of the whole universe; his love then extends to all that of which he is the essence, leaving no place for hate.

As a second example consider the question "Is God just?" By justice is meant equality of conditions and opportunities; or equal results for equal efforts of different individuals. As so defined justice is conspicuous by its absence from the universe. Paul claims that one vessel is made for honor, another for dishonor; and the inequality of conditions among men is patent. In the field of energy a very slight factor often makes the difference between intense action and almost no action. In matter, too, there is endless diversity of relation. And no two portions of either space or time are similarly related to the rest of the universe. Hence justice does not belong to the essence of the universe.

Justice is, after all, only a kind of rule-of-thumb that we apply to human affairs in default of fuller knowledge and stronger love. It is a negative standard, exceedingly defective, and wholly inferior to intelligent love. It could not be fundamental in the universe, and God is infinitely superior to it. In the evolutionary sense, God is not wholly good, but is becoming good; and he is not limited to justice because he has already gone far beyond it in unlimited love.

Whatever may be thought of the illustrations just given, the main contention of this paper is that it is now possible to apply the scientific method to investigate the characters of God. The facts of religious experience will ultimately be a great aid in such investigation, but as yet they have not been sufficiently studied. This method of investigation, being the most reliable and accurate known, must supersede all others and give later a scientific theology in which men of all creeds and races will agree.

In conclusion, the method of investigation here outlined and illustrated leads toward the center and source of being, which center is generally designated as God. The use of any other term instead of "God" would lead to wrong inferences. Outside of this center there is no known God, and he is known only through study of the universe.

T. Proctor Hall.

Vancouver, B. C.

ATOMISTIC DYNAMISM.

At all cost, we must have truth. It will be the achievement of the twentieth century.
Clémence Royer.

IT is indeed a great delight for progressive and enlightened minds to note the rapid growth of a great family of monistic thinkers, all united by their common recognition of the unity of substance in essence and quality in spite of its marvelous diversity in properties or modalities. It is an obvious fact that in the present day there exists among an even larger quantity of learned people a common sentiment that the fundamental laws and principles of the universe have been grasped at last, or that they will be grasped once for all in the very near future. If it is indeed true that much remains to be known in the immense field of human knowledge, we are fully conscious of what it is that remains to be known, and therefore we are in a far stronger position than those gentlemen who declare that they have received their light from the celestial power. We humbly recognize that there are yet many blanks in our science demanding to be filled, but we become full of hope on seeing that day after day these blanks disappear little by little, and that the hour is at hand when they will be reduced to their smallest expression.

Let us be assured that in reality our present position is strong and grows stronger day after day; that the immense number of facts and laws which the reason of man has already been able to grasp are all connected by a nat-

ural bond of clear logic and evidence. This is precisely the reason why our Japanese and Chinese brothers recognize them, just as our brothers in Great Britain, Spain or Russia. A wonderful thing indeed, that these notions and principles can have been so easily accepted by every lucid brain in the world, without the intercourse of any authority, owing to the mere virtue of their obvious evidence! At the present day there is a vast international movement of thinkers which is growing rapidly both in numbers and clearsightedness, and is already far stronger than the now worn-out fabrics of the various orthodox churches.

Much has been done in the last century, yet much remains to be done. Indeed every one of us, inside of his own individuality, always feels a natural, imperative, unceasing craving for a full understanding of the cosmos in its inward processes which the cleverest scientists in the world are yet unable to satisfy. As soon as a discovery has been made, enlarging the horizon of human knowledge, we immediately perceive in the distance unexpected vistas toward which our unquenchable thirst for truth impetuously carries us. "The known loses its attractiveness," wrote Claude Bernard, "whereas the unknown is always full of charm." There is no truce and no halt, no rest and no peace. Always we are longing for perfection, always we remain restless and anxious as long as something remains yet undiscovered. It is a natural necessity of our condition as thoughtful and reasoning creatures to puzzle our brains about the irritating question, What remains to be known?

When thought and reflection begin to awake in a man, the cosmos appears to him as a mixture of phenomena whose complex and contradictory character prevents him from perceiving the real mechanism. Upon further consideration we feel quite sure that all these various and multitudinous facts have a common and unique origin. Yet we must frankly recognize that, in spite of the theories built

patiently by so many thinkers, this unique cause remains to be found, this impulsive force of all motions is still a mystery. Wonderfully clever while dealing with small portions of substance, our experimentalists are becoming timid, hesitating and confused, and they even commit big mistakes when they venture to deal with the main laws of the cosmos. Even elementary explanations of some well-known facts or phenomena, such as atoms and molecules, ions and electrons, ether and ponderable matter, mass, force and movement, weight and attraction, fire, light and heat, electricity and magnetism, life and death, thought and sensibility, organic and inorganic bodies, are not in the least correlated in spite of so many endeavors; they are all competing and vying with one another in insoluble contradictions; these wrong explanations reciprocally cancel themselves. We may be sure that even our newest dictionaries cannot furnish us with satisfactory definitions of the above-mentioned words.

However difficult it may appear, the giant problem of the unity of substance must be attacked without delay by the help of the latest accomplishments in natural philosophy. At present, the mind wants to grasp a principle which will be duly recognized by all reasonable minds in the very near future as the primordial and efficient cause of that natural world of ours, as a creative and ruling cause, though atheistic and explainable in a purely natural and scientific way as an ever active and ever obeying cause, an ever living and ever varying cause. Indeed, the mind of man is naturally inclined to consider science, though infinitely ramified in its branches, as starting from a unique trunk or springing from a single germ. A unique force, a monistic law compels the sidereal spheres to follow their gigantic orbs through space, and the small material bodies scattered on their surface to share their destiny. In the same way, we understand that the beautiful green of our

vegetals, the sweet colors of our flowers, the gay concerts of our birds and the infinitely varied cries of the terrestrial mammals, the rays of our sun and pale light of our moon, the blowing of our winds and heat of our fires are some of the various aspects of only one substance, whose own nature, always and everywhere, remains identical with itself. We only wish to possess a fundamental principle connecting and correlating all these physical, chemical and organic branches of knowledge, and illuminating them with indisputable evidence.

We wish it and yet *we have it*. Though many monistic thinkers may be yet unaware of it, that fundamental principle has been duly found out, and the great monistic system which is its logical consequence has been built up once for all. Amidst so many timid scepticisms and backward reasonings, a daring and yet perfectly logical genius has definitely gauged and supervised all the renowned theories, eliminating all the wrong contained in them and wonderfully developing all that proved to be solid and really scientific. Careless about the bitter criticisms made at times by some self-important doctors, a French woman, who was a most intelligent disciple of Newton, Lamarck, and Darwin, spent twenty-five years of her life in elaborating a synthesis of natural philosophy such as the world had never known, a splendid work of truth and harmony which sooner or later will be recognized by all as one of the marvels of the past century and the most remarkable monument of science and knowledge ever created by the human race. With unparalleled acuteness, Clémence Royer has found out the very essence of things: she has intuitively discovered the true nature and mechanism of the etheroids; she has mathematically formulated the laws which rule the life of the cosmical substance and conducted her bold, though perfectly logical, inductions to their ultimate conclusions. Owing to the dynamic and substantialist philosophy built

up by Clémence Royer, all the effects whose causes we were formerly quite unable to detect, may be explained now in a quite satisfactory and scientific way. All or nearly all the riddles of the cosmos may be solved and become clear to our minds.

Owing to a logical induction made by Clémence Royer, we have now the striking proof that the substratum of the cosmos is force, substance and mind at the same time, that it is eternal and indestructible, that it fills the whole space with its expansible monads, everlastingly living and active. Owing to such an hypothesis, we understand that the cosmos is a "continuum" in which unities of substance or force are perpetually fighting. These antagonistic forces are becoming movements on the only spots where there is inequality or lack of equilibrium between them.

Thus force, the cause of movement, is a property of the atom. Force is inherent in the atom and cannot be abstracted from it. But it does not spend itself vainly in mad whirlings, as the energetists advance it, without giving any reasonable proof of such a fanciful idea. It does not spend itself in impossible *chassés-croisés* as the Clausius theory ascribes to the gases. Force is not a property of matter explainable by the old theory of inert atoms or mere geometric points separated by voids and without contact. It cannot be an enigmatic and incomprehensible mutual affinity of the atoms, an inherent power which brings them one towards the other and makes them seek one another. None of these various hypotheses has any scientific value; none can give us any satisfactory explanation of the natural phenomena.

If, on the contrary, we admit that starting from the center of the expansible atom its force radiates towards its periphery, pushing off on all sides the surfaces which the neighbor atoms oppose to it; if we admit that these atomic forces, owing to their inequality, have been the causes of

all the various phenomena which we see through the cosmos, then everything may be logically and scientifically explained, and the greatest part of the problems which remain unsolved in the minds of the scientists will begin to be elucidated.

Struggling perpetually among themselves, the atomic forces are mutually canceled wherever they are equal. The balance of the competing forces is set free where there are differences between them. There these differences are turned into motions. The sum total of the forces of the cosmos which spend themselves in motions, viz., the sum of the "living forces," is certainly very inferior to the sum of the forces which cancel themselves because of their mutual oppositions. Further, if owing to a supposed equality of the ethereal atoms both in force and volume only dead forces were present in the cosmos, its various phenomena could never occur. Being filled with actions and reactions all perfectly equal among themselves, the whole of the cosmos would resemble a kind of Nirvana deprived of any cosmical aggregation as well as any conscious existence. It is to the inequalities in expansible force of the unities of substance that the realities of the cosmos are due.

The atomic unity, the center or focus of force, is no longer this geometric point without volume, this tiny grain of sand, rigid, passive, without virtualities, that the atomists imagined. It is not the fanciful miniature of a solar system which the energetist school seems to take for granted and of which it gives us marvelous descriptions. The unity of substance is not a perpetual miracle whose nature and activities are impossible to understand, a mystery forever impenetrable for our brains, a world of dream and wonder much beyond the scope of the human genius. No, the atom is a reality, a living and active individuality. It already possesses in the lowest degree all the properties, all the virtualities of the organic being. It is owing to the oppo-

sition of the surrounding atomic forces upon its surfaces that an atom may become conscious of its immediate environment. It is the feeling of the atomic forces opposed to its own expansion by the neighboring atoms which causes an atomic unity to react against them. An atom, hypothetically isolated in the midst of a portion of space perfectly void of all matter either ponderable or imponderable, and without any contact with any other atom, would remain deprived of any sensation as well as of any kind of volition or impulsion from its substance. It could never become conscious of its individual existence. The psychical activity of an atom is the result, the logical consequence of its physical activity.

If force is the outward testimony of the atomic activity, a vague dawn of thought and conscience is the inward property of its substance. During the eternity of time, the atom is acquiring a perpetual sensation and consciousness of its environment. All the various sensations constantly felt by its surfaces converge directly towards its center. This science of the infinitely small which it is utterly impossible for us to acquire by direct ways because of the very bulk of our bodies, this science of the universal substratum is obtained by the minute unity of substance. If the tiny unity of substance is wanting in our far-reaching insight, in our variety and intensity of enjoyments, in the breadth, power and superiority of our psychical life, if it is wanting in this relative autonomy which enables us to study all our actions, to direct them in the way we prefer, to master them and control our reflexes when we choose, the humble atom has over the highly organized being the advantage of possessing a concrete and sound knowledge of the inward constitution of substance, which it borrows from the direct, immediate contact of its atomic world, from the convergence towards its center of the various vibrations which are transmitted to its surfaces by its neighbors. Thus the atom

acquires constantly concrete notions of the intrinsic nature of substance without being exposed to those acute feelings or sensations which our highly complex organisms suffer so often. This elementary life or consciousness of the atom may be compared to dreamless sleep in the animal world when the organic functions are at their lowest.

For the elementary unity of substance, the good, or the acme of happiness, consists in a perfect equilibrium of the pressures supported by its surfaces. Theoretically, the atom of ether, in the intrastellar space, assumes the shape of a rhomboidal dodecahedron, The dodecahedron is for the fluid atom the only geometrical form which allows an ideal equilibrium of the pressures supported by its surfaces together with the smallest possible expenditure of repellant energy. Yet the motions of the sidereal spheres through ether, and the heat radiated by these spheres into space unceasingly disturb the theoretical equilibrium of the ethereal monads, and prevent them from assuming the ideal shape of perfect dodecahedrons. Supporting unequal pressures upon each one of its twelve surfaces, the atom of ether is moving spontaneously, automatically, in the direction of the least resistance. As soon as its dynamic equilibrium is restored, it is brought to a standstill. The principles of ballistics which hold good for all kinds of material or ponderable bodies are not applicable to the unities of the intrastellar ether. The elementary living unities have an ethics of their own, an ethics which we human beings, placed for a short time on the top of the tree of life, should be morally obliged to consider. Not only are these ethereal monads the tiny motors perpetually under pressure which move the immense cosmical machine, but they constitute the greatest part of the universal substance and their number is infinitely superior to that of the material unities as well as to that of the organic cell-souls. It is to this vast intercosmic ocean that death gives back the trillions of vaguely

conscious and relatively free elements which constitute organic life.

In a lesser degree than the ethereal monads, ponderable atoms also possess their elementary psychical properties. In the ponderable or material elements, the atomic consciousness is at its lowest. In such a state, the atom appears to find itself in a kind of lethargy, in which suffering and enjoyment are confused in vague, blind sensations which never disappear entirely. Having for an unknown cause lost a portion, great or small, of their substance, the material atoms remain compressed into aggregations, owing to the pressures on their surfaces of the ethereal monads surrounding them. This being granted, we now see that the interatomic and intermolecular cohesion of the ponderable bodies are not the result of a miraculous and hypothetical attraction which the atom might possess. On the contrary, the cohesion of the ponderable bodies is for their elements a state of uneasiness from which they are ready to free themselves as soon as they can. All the phenomena of expansibility of ponderable matter—vaporization, volatilization, sublimation, even radioactivity—may be explained thus in the most natural and scientific way.

In spite of the fact that the cosmos contains a very small quantity of ponderable as compared to that of imponderable substance, the material aggregations constituting the sidereal bodies are formed of so great a number of atoms that the pressure of the ether on their surfaces is very often sufficient to keep their internal mass in a liquid state. Since these pressures of ether are felt on all points of the surfaces of the stars and planets, they assume a more or less spheroidal shape, as may be seen in our solar system. The differences existing in the pressures of the ethereal fluids surrounding the sidereal spheres and unequally heated by them produce the phenomena of weight and gravity. The differences in the pressures of the ether unequally

heated by the solar heat and by that of the major planets constitute the cause of the phenomenon of sidereal gravitation.

With these elementary notions of atomistic dynamism, we already see that in the field of cosmology as well as in those of biology, psychology, ethics and teleology, the theory of the fluid, elastic, indefinitely expansible unity of substance overthrows a very large number of prejudices and wrong ways of thinking still deeply rooted in the minds of many people, of erroneous notions which had been taught to us as a credo, without taking care to explain the how and the why, of many tabu words and sentences which filled our memory but had no meaning at all for our intelligence. In the same way, such a really unique theory of substance throws dazzling lights on all the sciences of organized life as well as on all those of our human race.

ARISTIDES PRATELLE.

CRITICISMS AND DISCUSSIONS.

THE PARADOXES OF PRAGMATISM.

A paradox is defined by a widely recognized authority as "an expression seemingly, though not necessarily, absurd or self-contradictory in its terms." When the intent of its language is readily apparent, the paradox may function as a vehicle for a bit of epigrammatic wisdom, or perhaps as a summary of a point of view. This may be illustrated by Oliver Wendell Holmes's comment on Berkeley to the effect that Berkeley's philosophy comprised two peculiar notions, one being that matter is nothing and the other that tar-water is everything. When the meaning is not clear, it is a potent device for arresting attention and provoking reflection and inquiry. In philosophic discussion the emergence of a paradox frequently marks the spot at which two independent lines of thought intersect. Each line has its own peculiar assumptions and to a considerable extent its own terminology. At the point of intersection, however, the two lines coincide for a moment, and one of the two becomes formulated in the language of the other. Hence the appearance of absurdity or self-contradiction, an appearance which can be removed—or else substantiated—only by a consideration and comparison of the fundamental differences in which it has its origin.

This being the case, it is to be expected in advance that a standpoint or doctrine which contravenes established credos and habits of thought will give rise to a multitude of paradoxes. Since the paradoxes bear witness to the divergence of the old and the new, they may even be used by the later philosophy to emphasize its originality. The classic instance is of course Hegelianism. From the riot of verbal contradiction there presented some have learned, indeed, to look upon all attempts at paradox with disfavor and distrust. To them it has become the index of a silly habit, not to say a disease. It is true that the paradox as an end in itself speedily becomes an offense, yet we can afford to recognize the fact that when employed

for the purpose of clarifying issues it may become an instrument of considerable merit.

To attempt an exhaustive enumeration of all the paradoxes that may be derived from pragmatic doctrine would be merely an exercise of ingenuity, similar in kind to a classification of all possible forms of nouns or of forms of logical fallacy. Some there are, however, which lie so near the surface that even a casual exploration brings them to view. We note, for example, that the pragmatist avowedly rests his case upon the deliverance of immediate experience, which would seem neither to require nor to admit of explanation. Yet we also find that he feels impelled to devote page upon page to a more or less successful elucidation of what everybody is supposed to know. We experience things just as they are, but in order to experience them we must first change them to something else. Moreover, while things are just what they are experienced as being, we may nevertheless make grievous errors concerning them, and only those who possess the correct criterion of truth and error can hope to be admitted to the temple of pragmatic wisdom. We know the world only in the form of experience, yet experience is but an incident in the course of cosmic events. Or, again, objects are known to us only in relation to the organism, yet these objects existed many ages prior to the appearance of experiencing organisms. The world, we learn, is wholly relative to our human purposes and activities, and from this relativity it is vain to seek escape, for relativity alone is absolute.

It was suggested a moment ago that in such situations the paradoxes have a common root. To explain one is in principle to explain all. Perhaps the shortest road to the heart of the matter is by way of the concept of pure or immediate experience. The most insidious of all philosophic fallacies, according to high pragmatic authority, is that of intellectualism. We easily forget that the intellect is only a tool, that it substitutes snapshot pictures for movement, cross-sections for duration, artificial boundaries and dead rigidity for everlasting flux. To know the real intimately and at first hand we must discard this conceptual machinery and plunge back into the living flow of immediacy. If we thus live the real it will reveal itself to us with a fulness and depth that passes all logical understanding.

On the surface all this may look like the dawn of an era of romanticism in philosophy. It is intimated that the dusty-minded professors who write about what other dusty-minded professors have thought, have had their day; if we are to know the truth, it seems

we must close up those barren leaves and prepare for silent communion, bringing with us only a heart that watches and receives. He that is thus equipped is in truth the best philosopher, the mighty prophet, seer blest, for on him, though deaf and silent, yet glorious in the might of heavenborn freedom, on him those truths do rest, which we are toiling all our lives to find.

Such a philosophy, however, seems to labor under the disadvantage of not being a philosophy. If immediacy is to be our touchstone, we must keep this immediacy intact at all hazards. To rationalize experience, to explicate it or accumulate knowledge about, is to transform it; which is only another way of saying that we substitute a new experience for the original one. But if this be the case, the second experience really tells us nothing about the first. The function of the truth-experience as a leading or guiding or pointing is admittedly something which does not operate through a fourth dimension to lay its hands bodily upon its object. Consequently we are shut in to the experience of the moment, and to say that there are other experiences is not so much true or false as unmeaning. It only remains to apologize for the phrase, "the experience of the moment," which is plainly unwarranted and misleading, since it implies a comparison with other experiences. Better then to desist, lest we fall into the error of the Grecian sage who wagged his fingers and thus blemished what would otherwise have been a spotless career.

Whether this is in truth the outcome of the pragmatic doctrine of immediacy is indeed a different and further question. The deductions that have just been traced have validity only when the pragmatic position is stated from the standpoint and the presuppositions of its opponents. The result of this combination is a fearful and wonderful hybrid, with which the chief of pragmatists disclaims all acquaintance, never, as he says, having met the beast. It is plain that somewhere there exist fundamental differences, which must be unearthed and set side by side, if the appearance of paradox is to be overcome.

What are we to understand by "pure" or "immediate" experience? For pragmatism—if I may venture to speak for it—the appeal to immediate experience as the final criterion means, or should mean in this connection, neither more nor less than the contention that the unknowable has no standing-ground in philosophy. Taken by itself, this doctrine has the amiableness that belongs to things trite and true, but it acquires an edge when followed by the

assertion that pragmatism is the only philosophy which does not operate with an unknown and inconceivable x in its interpretation of experience. To prove this assertion in detail is hardly possible at the present time. Such proof would require a review of the entire controversy concerning the nature of truth. But at all events the pragmatist himself has promulgated a doctrine of truth which, whatever its shortcomings, has never, so far as I am aware, been suspected of maintaining an entangling alliance with a *Ding-an-sich*. His facts are, without exception, definitely specifiable contents of experience. But his adversaries, so he contends, have persistently refused to be specific in defining the nature of truth. We all remember his oft-repeated complaint that, while his own cards are all on the table, he is compelled to play with an opponent who does not choose to show his hand.

As an illustration of the difference in standpoint, we may take the experience of recalling in memory a past occurrence. According to the more typical forms of realism, recollection involves a present consciousness which is connected with the past event by what is usually called the truth-relation. According to objective idealism, the past and the present are united in a time-transcending whole, this whole or totality being absolutely all-inclusive and constituting the basis whereon the truth-relation is founded. The pragmatist, on his part, takes the view that memory *per se* has nothing to do with truth. We have told the whole story when we say that in memory the event is experienced as having been experienced at an earlier time. To an orthodox epistemology a statement such as this is of course a scandal. What we experience in remembering must needs be a representative, or at all events a phenomenon, an appearance. Whether we set the recollection frankly over against the remembered event in a relation of "correspondence," or treat the recollection as a sort of embryonic whole, we must in any case provide a place for the relationship of truth. The relationship of correspondence, however, is, one might almost say by definition, an unexperienced and inexperienceable fact. What we are to understand by "reference" on this basis has not as yet been made intelligible. And the doctrine which holds that truth is a relation between the present experience and the complete, all-inclusive system in which it finds its fulfilment, is in no better case. If this relationship is necessary to give a meaningful character to the present experience, it is evident that the relationship is equally necessary in the case of experiences which, when tested, turn out to be erroneous.

In other words, the difference between truth and error evaporates. Moreover, the relationship in question is evidently not experienced by us, for if it were, we should be able to distinguish truth from error in advance of any process of verification. Nor can it be experienced by an absolute, since for the absolute there is no truth but only immediate intuition. And, lastly, this relation to an ideally complete totality must needs be to a considerable extent "implicit," which places it safely beyond the reach of our comprehension.

Another way of stating the divergence in point of view is to say that the pragmatist holds no theory of experience to be adequate which does not give proper recognition to its character as a temporal flux. Experience, as James says, is "always off its balance," ready at the slightest touch to change into something else. Truth is but a name for the process in which experience undergoes a specific kind of transformation. It is a process, a function, a doing, in which the end is experienced as the fulfilment of the beginning; it is not a static relationship. To treat it as static is to leave out of the reckoning this all-significant character of experience and, covertly or openly, to resign ourselves to the dubious mercies of the Unknowable. Despite the resort to a transcendental, truth finds its criterion in a beyond which is only verbally amalgamated with the present experience; the life of finite beings is hemmed in to appearances, and our ideal of truth "suffers shipwreck at the very entrance of the harbor."*

There is some reason to think that the idealist in particular has been oppressed of late years with the misgiving that all is not well with his theory. He has been at some pains to clear himself of the imputation that his theory is at bottom a correspondence theory; and in response to the gentle prodding of the pragmatist he has repeatedly affirmed that the intellect does not work in a vacuum but is intimately related to desire and will. Yet so long as an "absolute" truth is our criterion, the heart of the matter remains untouched. It is true that the idealist has been insistent these many years that we must have no dealings with what lies beyond experience. But unfortunately this insistence—which bears a certain resemblance to Rousseau's belief that he was the best of men—encounters an old-fashioned prejudice that program and performance should sustain a proper relation to each other. We hear much of system and coherence and rationality and consistency and the like, but what in detail constitutes the truth-relation or how truth is to be distinguished from error, it seems

* Joachim, *The Nature of Truth*, p. 171.

impossible to ascertain. As long as a finished and "absolute" reality or an ideally complete system is our criterion, we are of necessity forced back upon an undefined and undefinable correspondence or "agreement" as the measure of our success; and even the assurance that we are dwelling in the shadow of the sanctuary of absolute truth is small comfort for the futility of our labors. The "correspondence" is a thing-in-itself. Concerning the uselessness of the latter there is indeed much verbal agreement among philosophers; but generally speaking, we have retained the thing-in-itself, in so far as it is embodied in a mental habit, where it is insidious and dangerous, and have rejected it only as an explicitly formulated doctrine, where it is innocuous.

The whole matter becomes much more simple and manageable if we confine the truth-relation to situations in which a question is asked and answered. From this standpoint a recollection as such involves no judgment, no truth-relation to a beyond, no relation of a knower to an object. It acquires these characters only when a question is asked, when a hypothesis is entertained and tested. In such a situation there is no need to refer to an ideally complete experience, for to ask a question is in principle to suggest the process by which the hypothesis may be verified. For example, someone may mention to me a historic incident concerning which I am uncertain whether or not I have heard it before. It has a certain flavor of the "warmth and intimacy" which characterizes recognition, but I hesitate to call it such. "Do I remember it?" In asking the question I am already started on the road to verification. The question is not directed towards the universe in general, but towards certain selected portions of my past. I disregard such matters as the high cost of living, summer vacations and baseball games, and review my stock of information relating to the subject in hand. This process is not subsequent to the question and the hesitation, but it is their origin and source. "Is this object hot?" is not a significant and serious question to me, save in so far as I am already engaged in the act of touching it in order to find out. It is true of course that the test may encounter obstacles and the verification may never be completed. The point is, however, that thinking is not an independent activity, but the handmaiden of our active, non-intellectual activities. The thinking process has indeed its own principles of procedure, which we write down, more or less accurately, in our books on logic. And conformity to these principles is requisite, if the thinking is to attain its purpose. But the thinking is none the

less a tool or device. And the truth-relation has no meaning apart from this process of verification. It is wholly an intra-experiential affair; as Professor Dewey says, "the effective working of an idea and its truth are one and the same thing."[1]

The appeal to immediate experience, then, is paradoxical only from a standpoint which ignores this fundamental character of flux or transformation and experienced leading. Hence the elimination of the beyond reduces our world to an aggregate of unrelated units, since the beyond is charged with the function of providing coherence and unity. From this point of view immediate experience is but a name for fictitious and impossible mental states, and to base a philosophy on them is to make bricks without straw. The pragmatist who knows his business yields precedence to no one in the repudiation of this kind of thing. His immediate experiences are not a string of detached and detachable facts, but are total situations, which are clearly objective, yet knit together in the unity which we call individuality or selfhood. The life of the individual involves continuous adjustment, and in this process the constituent factors of his experience become organized and have their status and value assigned to them. In other words, objects are not "bare" objects, but are what we find them to be by virtue of the function which they fulfil as members of an experiential situation.

From this vantage-ground we may deal more briefly with the remaining paradoxes. To make of any fact an object of knowledge is to change it; that is, to change its value and function—and hence its character—within the individual experience. If we once drop the conceptions of truth previously criticized, this change ceases to be a paradox and becomes a simple and obvious fact. Similarly, to fall into error is not to mistake an "appearance" for a "reality" which lies beyond it, but to mistake the function which the fact in question should properly perform of guiding to a further experience. And this in turn amounts to saying that we can experience things just as they are and yet make mistakes concerning them precisely because reality and truth are not the same.

The remaining paradoxes, which have a more formidable appearance, may advantageously be considered together. Our world, it was said, is wholly an experiential world, in which the bodily organism is an important factor, and yet our human experience is a late arrival upon the scene. Our knowledge, therefore, of pre-experiential facts is of necessity wholly retrospective in character;

[1] *The Influence of Darwin*, p. 143.

and thus the question arises what we are to say concerning those events which eye hath not seen nor ear heard, nor yet enter into the heart of man to conceive until ages after the time when they occurred.

The difficulty raised by this question turns on the fact that, according to the view here maintained, these pre-experiential things or events did not become what we now find them to be until the moment when the experience occurs. It is not until the present moment that they acquire membership in that peculiar context which as a totality we call the individual experience. If it be true that the past is also subject to the universal law of change, we are obliged to infer that the change is not completed until it has reached a culmination in experience. However true, therefore, it may be that we are now dealing with events which are genuinely past, we seem to be the victims of a peculiar hocus-pocus, the upshot of which is that a genuine past is *created* at the moment when the experience of it takes place. Or, to put it differently, we seem to have here a case where knowledge defeats its own ends. We strive to know what things are like prior to or apart from experience, but only to find that the touch of knowledge rivals the transmuting potencies of King Midas or a Bradleyan Absolute.

The difficulty, here as elsewhere, lies in the incompatibility of two divergent points of view. The chief reason, apparently, why the dependence of our experience upon a sensitive organism is considered incompatible with the knowledge of past events is the ingrained tendency to regard the relation of organism and environment as external and mechanical. If the environment is viewed as ready-made and waiting for an organism to be miraculously injected from without and become adjusted *to* it, then any changes which the organism may bring about are necessarily fatal to the purpose of knowing. From the pragmatic standpoint, however, the relation is one of mutual determination. Consciousness, on this view, is not a distinct entity, but a type of behavior, a behavior which involves on the one hand an adaptive organism and on the other hand a change in the environment, of such a kind that it controls or determines the behavior. Consciousness is thus set off from other facts by being identified with that specific process in the environment whereby the conflict of opposing tendencies, instinctive and habitual, is adjusted and harmonious response is sought or secured. The basis of the control, then, is to be found in the attributes of objects, their hardness, their color, their distance, their age, or anything else. As long

as we avoid the objectionable doctrine of mental states, there seems to be no incompatibility between the reference to an experiencing organism and the objectivity of the experienced qualities.

The critic, however, will doubtless point out that this relationship of mutual determination does not apply to a past which antedates the experiencing organism. Even the exigencies of theory are no justification for the resurrection of a past that is long since dead and decently buried, in order to establish the relationship that is requisite for pragmatic knowing. But sober reflection casts a doubt on the correctness of this position. In some sense it is unquestionably true that the past is fixed and unchanged, *jenseits des Guten und des Bösen*. But what is that past of which the present is the culmination and the result? In discussions of time and causation it has been pointed out often enough that the future is not contained in the past as a wall is contained in the bricks out of which it is constructed. It is only a mistaken naturalism that can speak of a formula which will make the future as an open book, a formula which will enable its happy possessor to "read in his equations the day when the Greek cross shall glance again from the mosque of St. Sophia or England have burnt her last bit of coal." No intelligence, however great, could so comprehend a cross-section of cosmic history as to read in it all the details of the future. A given cause is not a cause until its effect has appeared. To call it a potential cause is merely to give it a name. In order to know the nature of anything it must be construed with reference to the result in which it terminates. It is in the result that the character of the cause finds its fruition or fulfilment. The result, moreover, does not simply endow its antecedent with the *name* of cause, but it brings to full reality the cause itself. There is thus a real identity between cause and effect. The character of transition, of coming to be, is precisely what we lose when cause and effect are arbitrarily kept asunder. "What the antecedents of anything are, not what they were, is never fully ascertainable nor fully existent except as we arbitrarily fix a date and refuse to pass beyond it. A world which has had a past is a world which will have a future. Undoubtedly its past was what it was and its future will be what it will be, but in so far as it is an evolution which has continuously a past and a future, its past is alterable and its future therefore indeterminate."[2]

Applying these considerations to the case in hand, we may venture the hypothesis that our knowledge of the past is a fact

[2] Woodbridge, *Philosophical Review*, March 1912, p. 142.

which stands to its object in the relation of consequent to antecedent, or of condition to fulfilment. Our knowledge of the past implies a change in its object, but it no more creates its object than any effect creates its cause. The past, like any other object of knowledge, acquires its status within our organized world of experience through a process of redetermination and thus appears in a rôle that is new. And if the process called knowing is genuinely an activity or change in an environment and not a passive mirroring of things, there seems to be no valid reason for calling the knowing "subjective." As was suggested before, the change in question is of such a kind as to read off the nature of things in terms of behavior. Whether we consider situations of simple attention or situations that involve deliberation and choice, we find a peculiar correlation of object and response which gets adequate recognition from no other theory. That experienced objects should inevitably function as constituents of a situation so completely permeated by the "personal equation" is not a fact to be deplored, but is precisely what is necessary to realize the end for which the experience takes place. It is only by becoming constituents of such situations that objects can reveal themselves. To ask what things are like apart from this change is like asking what a cause as cause is like apart from its effect. The cause as cause is a condition of the effect, and similarly the past must be described as a condition of the present experience.[8] True knowledge is adequacy of function in the control of response, and apart from this it can have no defensible meaning.

Experience, then, regarded as a temporal event, means that the things experienced take on a peculiar function, having reference to the control of bodily response. This function is part of the bone and tissue of things as experienced. As was indicated in the discussion of the truth-relation, the experienced object is immersed in the "free water of consciousness"; its being is a perpetual becoming; it never passively exists, but constantly acts. This intangible character of experienced objects, which we mutilate in the very description that we give of it, is what constitutes the experiencing of objects. Since experience is not imposed upon objects from without by the introduction of a distinct something called consciousness, but is a change which the objects undergo in order to guide more efficiently the behavior of organisms, the question whether this change

[8] Cf. Dewey, *Journal of Philosophy, Psychology and Sc. Methods*, 1906, p. 253.

conceals the nature of the objects can hardly be considered relevant. The change is precisely what makes possible both the question and the answer; as James remarks, there is no difference between the object as it was and the object as it is, when once the question is asked.

It is along these general lines that pragmatism seeks, and must seek, to reconcile the relativity of our experience to the bodily organism with genuine objectivity. Whether it can give a consistent interpretation of all the facts which it behooves philosophy to consider is a question which the future alone can determine. The only criticism, however, that can be effective is a criticism which meets it on its own ground, for in philosophy of all subjects there is a sad truth in the remark of Mrs. Carlyle that "it is the mixing of things that is the great bad."

B. H. Bode.

University of Illinois.

PROFESSOR JAMES AND THE PSYCHOLOGY OF RELIGION.

The psychology of religion is the distinctly American contribution both to psychology and to the study of religion. The Germans have now taken up the subject in their characteristically thorough manner, and a journal, *Zeitschrift für Religionspsychologie*, is being published, whose purpose it is to collect authentic data of the religious experience. But it still remains true that one needs only English in order to read the authorities in this field.

To Prof. William James more than to any other worker in this field is to be ascribed the wide present-day interest in the psychological study of religion. *The Varieties of Religious Experience* appeared only eleven years ago, but within this brief time a new branch of psychology has been fully established and a considerable literature upon the subject has sprung up. At least two other important studies had been published before this one, but it was only with its appearance that a clearly defined and wide-spread movement was started, the object of which was to collect, analyze and describe the data of religion, and to attempt to interpret and evaluate these data in their relation to the rest of human life.

Professors Starbuck and Coe[1] seem to have been the first psy-

[1] E. D. Starbuck, *A Study of Conversion*, 1897, and *Psychology of Religion*, 1899; George A. Coe, *The Spiritual Life*, 1900.

chologists systematically to collate and study large numbers of cases of the religious experience. Professor Pratt has also done good service in this direction. They used the questionnaire method for gathering their data. Coe confined himself to his own students and to classes of religious people of which he had personal knowledge, such as the ministers of a Methodist Conference. This is a safe method, for his personal knowledge of the bias of his "subjects" helped him greatly in drawing right conclusions. Starbuck has also shown a caution in using haphazard materials which later collectors might well imitate.

Those who have worked with President G. Stanley Hall, of Clark University, have sent carefully prepared question forms broadcast and have thus obtained answers from people of many classes and interests. This method of collecting general and uncritical answers from a large number of unknown people may have some value, but in reading the results I have thought that these replies show how people will respond to set questions rather than reveal the real meaning of religion in human lives. Such replies concerning such an intimate experience as conversion may reveal certain general types of this experience, but it is certain, I believe, that the one thing not revealed by such a collection of answers will be the essential meaning of the religious experience. In the lot there will be some serious and valuable answers, but how are these to be recognized?

There can be but one way to get valuable results by this method, and that is for the student of these replies to have in himself a right standard of what a religious experience ought to be and for him to apply this, his personal standard, to the cases he is studying. This is not high-handed imposition by the investigator of his personal religious taste upon all these data gathered from many other lives, for this bringing the religious experience under question to the bar of his own religious consciousness is the only possible method by which significant results can be had from such a study. This is what all of these collectors of answers about personal religious experience are forced to practise, although some of them do not appear to be conscious of their real situation. Otherwise the collection of data proves to be but a meaningless jumble.

The method of Professor James is much more fruitful. He selects a number of positive cases of religious experiences and tries to analyze and to understand the significance of these. He approaches a case from different points of interest, until one feels that he has

gotten all out of that experience that one man can get out of another's report of his interior experience. He announces at first that his is to be a study of personal documents. He invites us to attend to a psychologically "descriptive survey of those religious propensities" of man, "those more developed subjective phenomena recorded in literature produced by articulate and fully self-conscious men, in works of piety and autobiography."[1]

In the twenty lectures of his book Professor James treats a variety of religious experiences of widely varying types. He frankly chooses radical and unusual types of religious experience, thinking thus to get the thing he is after better isolated for purposes of study. Many objections have been raised to this method of selection, it being claimed that the result is a caricature of religion, just because eccentric and abnormal instances are presented. This criticism is just in part, but we do not have here a complete account of religious experience, and the cases cited are so pronounced as to give a decidedly wild complexion to experienced religion. However it can not be denied that the cases given are true religious experiences, and some of them are typical of large classes of religious experience.

Professor James's volume means to be a psychology of religion. It cites cases and talks about these, and yet there is little formal psychological analysis of the experiences given. In these pages there is clear analysis of religious experience, but it is of a broadly sympathetic sort rather than a minute scientific scrutiny of particulars. The usual order of the study is, first some brilliant paragraphs on the subject in general, as those on "Saintliness," which show profound insight into the meaning of the experience, and then a striking case is cited. But the cases are given as confirming the insights, rather than being so much data from which conclusions are drawn. The experiences cited impress me as being striking and interesting stories which our author is telling us between periods of intense study of our subject. These anecdotes illustrate aptly the point we are considering but they were not strictly necessary to the progress of the study.

In speaking thus I do not mean that the cases cited are not authentic cases, nor that they are not enlightening. They simply do not impress me as of great importance to this study. The real study here is not of these varieties of religious experiences, but it is the problem of the meaning of religious experience itself. The contribution made here is not that of a scientific investigation of par-

[1] James, *The Varieties of Religious Experience*, p. 3.

ticular instances of religious experiences. The real value of this book is in the record which it contains of the religious insights of a man who has a great genius in the sympathetic interpretation of human life. James's comments upon the experiences of others, acute as they are and usually true, tell us much more about James's own inner life than they do about his subjects. As announced at first, this book is a study of human documents, and fortunately for us the documents are mostly written out of the sympathetic insight of the author himself.

In reading Professor James's general work on psychology I am continually astonished by his penetrating and unexpected analyses of the contents of consciousness. Scarcely any element of consciousness, however unusual and undefined, has escaped his notice and appreciation. So intimately revealing are some of his insights that they produce an uncanny feeling in us, and we wonder who has revealed to this scientist our dark thoughts which until now have lain half-hidden and unformed in our own conscious mental processes. Such revelations as these are the result of a genius for noting the unusual in human experience.

The employment of this ability to see the unusual and half-formed elements of consciousness results in a valuable contribution to the general field of psychological observation. There is danger however that the results of such insight into the hidden places of the mind will get over-emphasized. We are so fascinated by being introduced to queer parts of ourselves, whose existence we but vaguely suspected, that we are liable to forget that after all these oddities do not constitute a very large or very influential portion of our every day working characters. We needed a genius to reveal to us these outlying possessions of our conscious life, but now we need to use much common sense in order not to waste too much time on these peripheral interests, thus neglecting the vastly more significant central experiences of our lives. It is doubtless one of the temptations of psychology to emphasize too much the unusual and abnormal life experiences, for these stand out and challenge attention.

The above is a general criticism which I wish to apply to *The Varieties of Religious Experience*. The instances of religious experience selected here are true instances. They are more than usually interesting, perhaps just because they are so various. But the cases here selected are too unusual to afford a basis for any very general conclusions as to religion. These unique and even eccentric experiences can not fairly be said to represent the experiences of re-

ligion which is the directing force in the lives of an unnumbered multitude of present-day men and women. And even in the lives of the men and women cited, these experiences were but moments of unusual exaltation, and not the daily religious inspiration by which they lived out their lives. It is valuable to know about these striking religious experiences, but a great number of deeply religious people shake their heads and say that this is not what they mean by religion. Professor James could have obtained much more valuable, but doubtless much less interesting, material without going so far afield. But as I have said, these selected instances do not very much affect the truth or value of Professor James's treatment of religion, for his knowledge of religion came but slightly from these cases.

The great value of Professor James's work is that it forces upon the attention of students of religion the religious experience itself. Since this movement for the psychological study of religion has been launched it will never be quite as easy or comfortable again for theorizers about religion to pursue their way all heedless of the central fact of their subject. It is significant that just in a time when the theoretical explainers of religion, and many of the preachers of religion, had made up their minds that religious conversion was an emotional illusion, the psychologists came forward with irrefutable proofs of the reality and value of this experience. Thus science, which had been thought to be the enemy of religion, came to its rescue.

The five essential elements of the religious life, which Professor James gives in his conclusion, are admirable.[3] But this summary does not come from the variegated cases of religion cited in the special sense in which the author indicates that it does. This knowledge of religion comes from a profound and sympathetic understanding of religion as a whole, and in the last analysis this sympathetic insight is due to a personality peculiarly gifted for such understanding. The method used in this book can scarcely serve as a model for those who continue the study of religion in the empirical spirit. This work, by its character, is necessarily only a beginning. It has served its purpose of shocking the rest of us into a proper attention to the religious experience, but a much more careful and fundamental analysis of this experience is now necessary.

I think Prof. James H. Leuba has gone as far in the psychological method of studying religion as any other. Leuba objects to

[3] *Ibid.*, p. 485.

both the "intellectualistic and affectivistic conception of religion," for neither an intellectual interest nor a feeling can explain the origin of religion. Religion arises out of man's distinctive characteristic as "thinking desire" in the Aristotelian sense.[4] He says that "active religion may properly be looked upon as that portion of the struggle for life in which use is made of the power we roughly characterized as psychic and superhuman."[5] Religion arises from the same natural spring as does non-religious life, i. e., the "will to live," and the only ground for differentiation between the religious and the secular is in the nature of the forces which religion attempts to press into service.

That which differentiates religious life from all other expressions of man's life is not a specific feeling or emotion, nor yet a distinctive impulse, "for there are neither specifically religious motives nor specifically religious feelings."[6] A feeling is just a feeling, no matter what its cause. So religion is characterized only by the peculiar kind of power which it seeks to employ. "There are but three necessary attributes to a religious source of power. It must be a psychic, not a physical power; it must be accessible to man; it must be superhuman."[7]

So religion is an attitude which runs through man's whole life, intellectual and emotional. Religion is not a state either of mind or of emotion, but is one of the ways by which a man seeks his life. It is "a belief in a great and superior psychic power—whether personal or not. A dynamic relation between man and that Higher Power tending to the preservation, the increase and the ennobling of life."[8] Man's thinking, willing and emotional activities are all concerned in the religious attitude.

Now it is evident that Leuba did not reach his conclusion as to the nature of religion by means of psychology in the ordinary definition of this science. Religious feelings are just feelings, like others, he has said. So a psychological analysis of these feelings yields nothing different from that found in the other feelings. No such analysis can find out what is the nature of the object toward which these emotions are directed. Where did Leuba get his definition of the God or "Power" of religion then? To be sure he could

[4] Leuba, *The Psychological Origin and Nature of Religion*, p. 6.
[5] *Ibid.*, p. 93.
[6] *Ibid.*, p. 14.
[7] *The American Journal of Religious Psychology and Education*, Vol. II, p. 325.
[8] *The Psychical Origin and Nature of Religion*, p. 92.

have found out by empirical observation that religion seeks to employ a different kind of power from that sought in the ordinary life of man, but he does not stop with this observation as to the direction in which religion seeks to go, for he says it is a "dynamic relation between man and that Higher Power." Thus he knows much about religion, but he does not explain by what method he obtained his information.

Psychology can help us in our study of religion, just as anthropology can, by giving us an array of dependable facts concerning religion. The facts gathered by psychology deal with the inner life and are thus nearer to the real center of our interest. But if Leuba is right in maintaining that there are no distinctly religious emotions and feelings then the science of psychology can not carry us very close to the real solution of our problem. Religion itself still eludes us, for we are only psychologizing about the effects which religion produces in the life. The cause of these effects, religion, would always remain unknown.

Leuba says that in his opinion "the amazing discrepancies and contradictions offered by authorized definitions of religion arise from a faulty psychology."[9] To this I agree in part. The definitions of religion with which I am acquainted are all true, as far as they go. Their undependableness arises from their onesidedness, and this may arise from neglecting the psychological side of the study of religion, or from neglecting the ethnological side or the philosophical side of this study.

In the psychology of religion the psychological analysis is not the simple scientific operation which it is usually assumed to be. If the feeling, willing and knowing of religious experience are just common feeling, willing and knowing, then the mere psychological analysis of the religious consciousness will reveal nothing as to the distinctively religious aspect of the experience. The psychophysical parallelist would say that this is just the situation, for that essential meaning or value which constitutes the religious element in the experience can not be reached by the methods of psychology because that value lies not in the existential world but only in the realm of appreciation.

We have just here a good example of how this parallelistic way of explaining human experience must break down. This evaluation is also a fact of consciousness. If our methods of psychical analysis do not reach this item of experience then they must be extended

[9] *Ibid.*, p. 5.

until they can reach it. To be sure the evaluating factor of consciousness is purely subjective, i. e., can only be certainly known by the experiencing consciousness itself, and therefore can only be found by the introspective method of analysis. Each person must find his own religious value within his own experience, but having found it he then has a standard of value to which like experiences in other lives may be referred.

The answer is made that no one can observe this value judgment in any experience except his own, because it is entirely subjective. But this is not quite true, for all conscious experience is in this sense entirely subjective. We can not tell that a man has a feeling of pleasure by any direct method of observation. It is only by referring what we observe of the man's mental state to a standard of pleasure which we have in our own consciousness that we can judge him to be pleased. So there must be this reference to our own personal experience in order to judge the results of any psychic analysis. In studying the religious value judgments of other lives we have simply an extreme case of this necessity of reference to a subjective standard.

In studying the life of another we come upon certain phenomena which we recognize as religious, and we know this part of his experience to be religious because we ourselves have had a similar experience and know what it means. This is a species of immediate recognition, for our religious standard has become so a part of our consciousness that through it we immediately recognize that which is like to it. This is not just reasoning by analogy, i. e., when I acted as this man is acting I felt so and so, therefore he must feel so and so. While our knowing the religious value judgments of other people is in a general way by analogy, yet this is usually not an elaborate reasoned process but rather an immediate recognition that what he now has is what we call religion.

Thus we can know more about another's religious life than that it shows certain marks or has characteristic direction. We can observe more about the religious consciousness of another than that it strives to reach a peculiar object, e. g., one that is psychic and superhuman. By sympathetic interpretation and an imaginative entering into this experience of our fellow man we know what his religious life means. This recognition is of the general type of poetic interpretation, only it is more intimate and serious because the issues are real and solemn. It was by this method that Professor James arrived at his wonderful insights as to the meaning of the

religious experiences of other men. It was not necessary for him to have in his own life all those eccentric religious experiences which he so truly describes. It was enough that he had in his own experience the touchstone of interpretation by which he could sympathetically enter into and illuminate those heterogeneous experiences. To this, of course, he added a genius for expression.

Unless the psychology of religion is willing to remain a formal description of the external psychic manifestations of religion it must extend its scope by frankly including this method of interpretation by intimate personal reference. Otherwise it can not at all give the meaning of religion. But no psychologist has been content thus to limit himself in his study of religion. Leuba, one of the most carefully scientific of them all, ends by defining religion as a dynamic relation between man and God.[10] After all it is the real meaning of religion which all students of it wish to find out. This being no less true of the psychologist than of other investigators of religion, he had best openly avow and carefully employ the only method by which the true nature of the religious life can be found.

This more thoroughgoing method of studying religion, which I can only suggest here, is not one of mere introspective analysis. Such self-examination is the initial step in this method. One must come to an understanding with himself as to the meaning of religion, and this will be impossible if he has no personal experience of religion. But this personal standard must be tested by all possible methods of outward reference to the phenomena of religion. We must seek to know what religion has been historically in its various stages of development. We must analyze psychologically many types of religious experience to see what religion has been in the lives of other men. These phenomena must be philosophically interpreted that we may see their connections with other regions of men's interests. Thus by the employment of all means at our command are we to seek to know the essence and meaning of religion. And it is fundamentally important to have in mind what particular method we are using at any given stage of our investigation and to conform to the limitations of that method. But in the use of no method, however scientific, will the investigator ever be able to get away from the necessity of direct reference to the individual religious consciousness.

EZRA B. CROOKS.

NORTHWESTERN UNIVERSITY.

[10] *Psychological Origin and Nature of Religion*, p. 90; also *American Journal of Religious Psychology and Education*, Vol. II, Nos. 2-3, pp. 312-313.

MADAME CLEMENCE ROYER.

Madame Clémence Royer, an eminent scientist and philosopher, was prominently before the French public during the last quarter of the nineteenth century. She received much recognition from scientists and men of letters, but since her death she has been almost forgotten. *The Open Court* contains some of her contributions (IV, 2413; 2426) which were mainly criticisms of the editorial view, and the editor made her personal acquaintance in Paris in the summer of 1900. His reply to her criticism has been incorporated in his *Fundamental Problems* (pages 324-332). Portraits of Madame Royer, taken in 1865 and 1899, were published in *The Open Court* of September, 1900.

M. Aristides Pratelle revives her memory in the present article on "Atomistic Dynamism," under which caption Madame Royer's theory might be summarized, and we gladly offer our columns for the presentation of the philosophical system of this distinguished woman as presented by an independent and intrepid follower, who speaks in the name of an organization devoted to the propaganda of Madame Royer's synthetic philosophy.

We will say that Madame Royer's theory is remarkable mainly on account of the mathematical and scientific substructure upon which it rests, and also the detailed elaboration of her views in which one recognizes at once an author who is well posted in contemporaneous science. Although we admit that we agree with her in many respects and do not hesitate to approve of the monistic tendency of her work, we are nevertheless at variance with her propositions on several most important points.

First of all we take little interest in the oneness of the substance of the universe. We believe that the oneness of substance will ultimately be proved. We do not assume that there is a plurality of divergent ether atoms, or that there are several ultimate substances of which the world consists. We think that ultimately the substance of reality from which this marvelous cosmos has developed is throughout the same, and yet we deem it of little consequence, because our monism is not built upon the theory of oneness of substance but upon the oneness of law, the oneness of those uniformities which dominate the development of existence and produce the cosmic order in which every formation appears conditioned by cause and effect. All becoming is transformation and the laws of form are

the means by which we trace the necessity of all events under definite conditions.

In a similar way we take less interest in upholding the theory of atoms as an essential part of the monistic or scientific world-conception. The atom in our opinion is a convenient mode of representing certain proportions in the specific weights of chemical substances, and it is very probable that there are definite and discrete portions in which these small aggregates of matter are combined and interrelated with others of different kinds and qualities. We might, though not without hesitation, let the statement pass that the atom is a "living and acting individuality" if we take the word individuality in the sense of being a definite, discrete thing, but we object decidedly to the proposition "that the atom possesses already at the most inferior degree all the properties, all the virtualities of the organic being."

We have repeatedly insisted on the obvious truth that combinations produce new qualities. As in mathematics the idea of a triangle can not be deduced from the idea of the line, so the character of a steam engine can not be derived from the parts of which it consists, nor from the properties of heat. A new combination possesses new qualities and the new qualities which originate by the combination will account for qualitative differences in existence. The idea that everything must be measured quantitatively in order to admit a scientific explanation is an error. The different things in the organic world and also in the domain of psychology, the different beings possess different qualities, and these qualities are the most important part of existence. Thus there is no need of saying that all the phenomena of higher life, or organized nature, of the soul and even of social interrelations should exist in an inferior degree in the atoms of inorganic existence.

Though we do not agree with Aristides Pratelle, and with some of the most important aspects of Madame Clémence Royer's atomistic dynamism, we believe that she has not received the attention due to her, and the recognition of her philosophy has been out of proportion to that of other philosophers who were inferior to her extraordinary abilities. It is not impossible that this neglect is due to the fact that being a woman she was not deemed of sufficient importance to be taken seriously. For this reason we are glad to take this opportunity of having M. Pratelle explain the proposition of this monistic conception which seems to find a potent support in the new

theory of liquid crystals, the nature of which has been lately much discussed.

In the *Literary Guide* of September 1, there appeared an excellent biographical sketch of Clémence Royer from the pen of Mrs. Hypathia Bradlaugh Bonner. It is distinguished by brevity and completeness giving a vivid account of this remarkable woman's intellectual development, and we deem it a service to our readers to reprint it here in full. We would call attention to the strange fact that those who struggle for the liberation of the human mind are generally distinguished in their early life by a strong religious fervor which goes far to prove that the ultimate motive of liberal leaders is of a religious nature.

* * *

Clémence Auguste Royer, economist, anthropologist, mathematician, physicist, and uncompromising rationalist came of a profoundly religious and royalist family, and was born at Nantes on April 24, 1830. She was educated at the Convent of Sacré Cœur, and is said to have been destined for a religious life. In 1854 she visited England, and during her stay there she made herself acquainted with the English language and literature; two years later she left that country to go to Switzerland. By this time her eyes had become opened to the errors and evils of Catholicism; but, although she rejected the authority of the pope and ceased to believe in miracles, she was still so deeply religious that in the summer of 1856 she resolved to follow exactly what she supposed was the practice of the Christianity of the first three centuries. Following up this idea, she conceived what she herself later called "a childish dream, the fruit of my monastic education," of living an anchorite life, and in solitude awaiting prophetic inspiration.

Passing through Lyons on her way to Switzerland, she proceeded to give effect to her ideas by devoting nearly the whole of her little patrimony to succouring the distressed victims of the inundations of the Rhone. Had she not been restrained by her family, she would have given all. As it was, she arrived at Lausanne penniless; but, fortunately, she was a clever needlewoman, and obtaining a poor lodging at fifty centimes a day she supported herself for a time by her needle. Lausanne, however, was not exactly suitable for a hermitage, so she determined to go to the Tour de Gourze, a lonely spot which she remembered to have visited with her family as a child. Here, at an isolated farm inhabited by an old couple, Clémence Royer took up her abode, paying twenty francs a month

for her board and lodging. Her room was small and bare, but from the window she had a magnificent view of Lake Geneva; her meals she took with the old people, who lived with the utmost frugality.

Once settled at the farm, she began to reflect upon her position, and it was brought home to her that it was only because she was prevented from obeying the injunction to give away all she had to the poor that she was able to pay the farmer the trifling sum required for her bed and board. It appeared, therefore, that it was not possible to take Christian teachings literally in the nineteenth century. But if Christianity was impracticable, could it be divine? Putting this question to herself, she submitted the Gospel teaching to examination, and came to the conclusion that it was contrary to the economic condition of society, and, in fact, so absurd that anyone who tried to carry it out would be looked upon by Christians themselves as crazy. This was sufficient; she was cured of her desire to become an anchorite. But, having arrived at this point, she suddenly felt isolated, cut off from the rest of her world, from her family, her former teachers, and the books upon which she had been nourished. One thing remained to inspire her then and throughout her life—her faith in truth, and in the possibility of discovering it. It was to this task she resolved to devote herself.

She made arrangement for a service of books from the library at Lausanne for the small sum of twenty-four francs a year, and her work of education began first by dismissing from her mind all that she had already learned, and then by studying as far as possible in the originals the latest works she could procure in science, history, and philosophy. In this way she passed the winter of 1856, entirely alone save for the two old people of the farm and for the infrequent occasions when she went into Lausanne to consult the library catalogues. It was a walk of about seven miles, and she went in in the morning, returning unafraid, by steep and lonely paths, in the darkness of the winter's night. After twenty-two months of this secluded and studious life, Clémence Royer was as one new-born; she had shaken off the last shreds of her belief in Christianity, and had reached certain rational principles of philosophy, which she continued to affirm and develop during the rest of her life.

In 1859 she left the farm, and went to live in Lausanne to be near the library. In the following year she gave a course of logic and philosophy for women, in which she maintained the theory of evolution; this being the first course of rationalist philosophy ever

given in French Switzerland. About this period also she contributed a series of articles to the *Nouvel Economiste*, founded by Pascal Duprat, a refugee from France, to whom she became united. In the year 1860 the government of the Canton de Vaud, anxious to discover a rational and equitable system of taxation, involving the least possible friction, yet providing the revenue necessary for good government, invited economists to compete for a prize on this difficult subject. Clémence Royer entered for the competition, and the prize was awarded to her jointly with Proudhon. Is seems a strange irony that Proudhon, who declared that women ought not to be considered responsible before they had attained the age of forty-five, that they were incapable of genius, and that there were only two rôles open to them, those of courtesan and housekeeper, should have had to divide a prize with a woman upon such a subject as "Taxation." Clémence Royer's treatise was published in 1862, and makes a massive volume of 750 closely-printed pages; for, although it was written in response to the special needs of the Canton de Vaud, the subject is treated in the widest possible manner. It is no mere dry treatise of figures, but is an exceedingly interesting review of the origin, general theory, and differing practice of taxation.

Hardly had this work left her hands than this young woman of thirty-two, bred in the narrowest Catholicism, proceeded to a task with which her name must be ever associated—viz., the translation, with Darwin's authority, of his recently-published *Origin of Species*. The translation appeared in Paris in 1862, just three years after the original publication, and it was through this translation that the French reading public first made acquaintance with Darwin. Mademoiselle Royer introduced the subject to her readers in a notable preface of some fifty-four pages, which she was inspired to write in response to the violent attacks made upon Darwin and his German translator by the clericals in England and Germany. The clergy everywhere, she said, pretend not to be the enemies of science; if one may believe them, they would even protect it, provided it would consent to stay docilely within the limits they lay down. They had, however, learned by experience that there is hardly a conquest of the human mind which has not encroached upon their domain; not a discovery which has not made a breach in their system. It had been contended on Darwin's behalf that his theory was not antagonistic to religion; but Clémence Royer's nature detested all ambiguities, compromises, or evasions, and she declared it to be

profoundly heretical; as heretical as the theories of Lyell, which abolished the universal deluge; as heretical as Newton's gravitation and the Copernican system, which denied the star's power to guide the Magi to the cradle of the Messiah, and would not allow Joshua capability to stay the movement of the sun. This preface, the whole of which well deserves translation, aroused a considerable storm among orthodox people, but decidedly enhanced the reputation she had already made by her book on taxation.

No sooner was her translation of Darwin's masterpiece launched than Clémence Royer began another work, and in 1864 she published in Brussels a philosophical romance entitled "The Twins of Hellas," which seems to have been prohibited in France. In the same year also she wrote an Italian essay upon "The Future of Turin." Six years later she published what was for long considered her ablest and most original work, "The Origin of Man and Society," in which she reaffirms the rational scientific theory of evolution and traces out the origin and development of life and thought upon earth, and the history of man as individual, and of human societies. This was followed by several other essays, displaying great research and originality of thought, such as "Funeral Rites in Prehistoric Times," "Hypothesis of Heredity," and "The Good and the Moral Law," besides many valuable contributions to the French General Encyplopædia, and to anthropological and economic reviews.

Always a student, and always eager "to combat the proselytism of the absurd by the proselytism of common sense," in 1900 this remarkable woman, having reached her seventieth year, brought out her last great work, the crown of her career, the result of five-and-twenty years' labor. This book—a thick volume of 800 pages—is entitled *La constitution du monde; Dynamique des atomes; Nouveaux principes de philosophie naturelle.* In the preface to this last work of hers she takes vehement exception to the use of the term "unknowable." Her vigorous mind loved bold affirmations; she had no sympathy with hesitating or half-hearted acceptances of great truths. She thirsted to understand all, to explain all; she refused to admit the "unknowable." The only unknowable to reason, she said, is that which does not exist. There is nothing incomprehensible but the contradictory, which is the impossible. The things which science will never know are the wild visions of the human imagination, which seeks to give reality to its ignorance; fantastic dreams of the night taken for the realities of the day; errors born of falsehood and exploited by credulity.

In her old age life was not kind to Clémence Royer. On the fall of the Empire, Pascal Duprat was able to return to France, when he was elected deputé, and Clémence ably seconded him in his political career. But Duprat died in 1885, and Clémence, by degrees, fell into ill health and complete poverty. Her last days were passed in the Asile Galignani, where she died on February 5, 1902.

To-day, as we recall the sanity and vigor of her intellect, the simplicity and clearness of the language she used to explain her ideas, the devotion and loyalty with which she consecrated herself to the search for truth, we feel that her name should be written in letters of gold on the imperishable roll of the servants of rationalism and humanity.

THEONOMY.

WITH SPECIAL REFERENCE TO DR. T. PROCTOR HALL'S "SCIENTIFIC THEOLOGY."

Believers in God find it more and more difficult with increasing scientific knowledge to retain the old theism, and so they either turn atheists or modify the old conception of God into one that is more or less scientifically tenable. On another page of this issue we have a remarkable example of this latter tendency in the article "Scientific Theology" presented in elegant brevity by Dr. T. Proctor Hall, a man whose knowledge in the natural sciences has rendered it difficult for him to accept the traditional God-conception of orthodox Christianity, and yet who is not shallow enough to be satisfied with a crude materialism or the current atheism of to-day, and truly his aspiration is justified. The traditional God-conception has stood for great realities in the endeavor of progressive mankind, for the ideals of social justice and the attainment of truth. The idea of God thus formed was certainly not in vain and must have served—yea is still serving—some good purpose in life.

The neatness with which Dr. Hall builds up his philosophy is admirable, his elucidations render his thought plausible and even acceptable to those who incline to his way of thinking, and yet his method is fallacious and some of his arguments lead him astray, so that we here propose to point out briefly the mistakes from which his presentation suffers. However, we will find that, after all, his ideal of preserving a God-conception can be maintained, although the God-conception which we consider as delineating the God of science would be somewhat different from his, but in many

respects it preserves the old traditional conception of God even more faithfully and better than his.

What Dr. Hall calls the cosmic elements had better be called ultimate universals, and he ought not to arrive at their conception either by assumption or any haphazard enumeration. The procedure by which we propose to discover ultimate universals would be that of abstraction and generalization. We must start according to the positivist principle from the facts of experience. We analyze our experience and systematize different qualities under different heads, and again, the different classes that belong together as different categories, until we reach an ultimate, beyond which we cannot go.

In thus systematizing the characteristics of our experiences, we reach not one ultimate generalization, but three: substance, energy and form. Under these three heads we can subsume all features of the innumerable things that present themselves to our experience in the objective world. Dr. Hall first enumerates four, (1) time, (2) space, (3) matter, and (4) energy. But we regard time as the purely formal element of energy, and space as the purely formal element of matter, and so we suggest to replace Dr. Hall's four elements by three ultimate generalizations, (1) matter, (2) energy and (3) form, whereby it is understood form includes every kind of relativity, not only shape or figure, but internal interrelations or structures as well, and also that uniform idea of motion called time, the units of which can be counted to determine duration.

We repeat that the whole objective world possesses everywhere in its constitution these three universals, or as Dr. Hall calls them "cosmic elements," form, substance and energy. Nowhere is there any objective existence which does not partake of all three at once.

The "three ultimates" is a term which means that the object confronting us in our experience is (1) real, i. e., it exists independently of us; viz., it is objective; it consists of substance or matter. Further, (2) it is actual, i. e., it acts or reacts; it possesses energy; it moves; it suffers the impacts of motion and in return gives out impulses; it causes motion; and finally (3) it is of a special kind, of a definite form in space and time.

There is a peculiar aberration in philosophy called agnosticism according to which man does not know and never will know what matter is and what energy is. Agnostics are not aware that there is nothing to be known about either matter or energy. These generalizations are simply the *that* of existence. They are not unknown

quantities, but the universal feature of existence denoting what all things have in common. It is not strange that we should know what gold is and what iron, or wood, or sand is, but that the quality which all these things have in common should be inscrutable! By matter (or better "substance," wherein we include ether) we understand existence in general and we grant that while science is or may be able to trace the form of our present existence from the form of prior states, we can never explain why there is something at all, and why there is not in its place nothing. That existence exists and that it acts, that something is going on, is a fact, and the question why existence exists is an illegitimate question.

Science does not concern itself with the question why existence exists. It investigates the nature of existence by studying its forms and tracing its transformations. Thus the third quality of things, their form or suchness, is the most important quality of existence. There is nothing to be known about the innermost being of matter or of energy. There is no philosophical problem about either. Both are simple statements of fact meaning that a thing is and that it acts. All truly scientific problems deal with the form of existence, and the purpose of all knowledge consists in tracing how forms originate from prior forms and how they change according to the laws of form. If we can trace them to a uniform primordial condition of the ultimate world-substance and can show the whirls in which the actual elements of matter originate from this primordial world-stuff (presumably the ether) by some unexplained commotion, we have reached the aim of the ultimate problem of cosmogony. There are no problems in the conceptions of substance and of energy. Energy is simply change of place—or rather the activity in the change of place, which however is ultimately the same thing.

So far we agree in the main with Dr. Hall. We have only simplified his cosmic elements and reduced them to three ultimate generalizations. They cover the whole realm of objective existence. But, as he correctly states, there is another cosmic element, the existence of which he concludes from the sporadic appearance of consciousness, and it is in this connection that we find the ultimate source of his error.

First we must notice that in speaking of consciousness we enter into an absolutely different domain of our experience. No consciousness can be discovered in the objective world. Consciousness is a purely subjective phenomenon. For all we know it need not exist at all in the objective world. The objective world is char-

acterized throughout as matter changing form. It is true we assume that creatures like us are ensouled with the same feelings according to their bodily form, that the words which we hear are accompanied by the same thoughts, but this is a mere assumption based on an analogy; and suppose a thinking subject could be imagined devoid of consciousness we would not be entitled to assume that there exists outside of us any consciousness at all. No one, however, doubts that our fellow creatures are according to their organization ensouled as we are with more or less or no feeling, from the range of self-consciousness possessed by a thinking man down to the primitive sensibility of monera and amebas, and still further down to the irritability of plant life and the zero of sensibility that appears in purely physical phenomena.

In considering the existence of such a cosmic element we must strictly distinguish it as an element of its own kind which cannot be numerically added to the three others, either as a fourth or, as Dr. Hall has it, as a fifth. It is not objective and is not traceable in the objective world. It is subjective and it corresponds to the phenomena of the objective world. It differs from energy and matter, but its appearance and disappearance, as well as its intensity, depend upon the discharge of energy in the manifestation of bodily forms.

On former occasions[1] we have characterized the three ultimate generalizations of objectivity as the outside of existence while the subjective phenomena are its inside or inwardness. Both are two aspects of one and the same thing, and this theory has been called in psychology the theory of parallelism. We confess that the term "parallelism" is inappropriate; for there are not two realities, body and soul, objective existence and subjectivity, matter and spirit, brain and consciousness, acting in two places side by side parallel with each other, but there is one reality which in itself is feeling but when met from without appears to sense activity as material corporeality. Whatever a feeling feels, or a sensation senses, presents itself as matter in motion. Even a human person appears to others as a living body; his soul can not be seen; his feelings are invisible; his emotions can only be guessed from his behavior, especially his words and the expression of his face.

The conclusions from this conception of existence would lead us to the theory that all existence is endowed with potential feeling, that under definite conditions actual feeling originates, and that in

[1] See *The Soul of Man*, pp. 25 and 29; also *Whence and Whither*, pp. 7-15.

such actual feeling, as we assume forms itself in primitive animal substance like amebas, mentality begins to appear. The preservation of the forms of the physiological conditions of feeling in their connection with feeling is called memory. If a sensation of a definite form is registered in the brain-center of the same class, the old memory picture of all former pictures of the same form are revived, and as a result the perception of sameness originates. Thus it comes to pass that sensations become representative. When feelings become representative they denote the causes of sensation and thereby build up the soul, for the soul is a mirror of the world; it is a system of sentient symbols. There is not room here to explain further details which we have discussed previously on various occasions. We will limit ourselves to the statement that the substratum of consciousness must be the most primitive general condition of consciousness which we call subjectivity, and cannot be the highly complicated phenomenon of spirit.[2]

Of course every one is at liberty to coin new terms and Dr. Hall may understand by "spirit" exactly what we call subjectivity. We describe this subjectivity in its simplest form as potential feeling. It is that interior of reality which, viewed from the outside, appears as some form of matter in motion; the inside assumed to be according to its form a definite kind of subjectivity from which develops first irritability, then feeling, and at last consciousness, and at the same time thought, mind or spirit, the rules of which are formulated as reason.

Reason is the comprehension of a purely formal aspect of law in the objective world. In this generalized conception we notice a correspondence (or if you prefer, a parallelism) between the subjective construction of law in general which is reason, and the lawdom[3] (or, as the Germans call it, *Gesetzmässigkeit*) of the objective world.

The pious Christian may now ask, Is this not an atheistic philosophy, leaving the world without God and depriving man of his hope of immortality? But such is not the case. We must approach the God-problem in a practical way. We must not construct an idea of God and then, as did Kant, postulate it. We must ask what has been the significance of the God-idea in the history of mankind.

This question as to the significance of God has been variously answered and mostly in the wrong way. Man does not worry about

[2] For further details see *Philosophy of Form*, pp. 24-26.

[3] Lawdom is coined for the purpose of exactly translating the German term and expresses a much needed word.

the unknown and he ignores the unknowable. He worships only that which he knows, that which he fears, that which can hurt him. God must be a reality. Man's notion of God has been ascribed to a special revelation which has been accredited to an incomprehensible manifestation of an unknown power. Belief in God has been declared to be a special merit even in spite of logical difficulties. This is the old orthodox conception of God. Liberal thinkers, among them Herbert Spencer, have no room for a God-conception but replace it by the metaphysical x, the unknowable. But neither is this correct. Not the unknown or unknowable is deified, but those same known powers in the face of which man stands in awe. Man deifies what he fears. It is the half-known, the unintelligible, the terrible, the overawing which is deified rather than the harmlessly distant unknowable, and this has been developed in the course of time into a personification of all those factors of man's experience which he cannot fathom, which he must heed, to which he must submit, through which if he heeds them he is benefited and blessed, whereas if he acts contrary to them he is either severely punished or doomed, and these factors in their oneness we have briefly described as the authority of conduct. God everywhere appears as the ruler of the universe, the judge, the creator and preserver of the world; or, as it might be expressed in more philosophical language, he is the factor that determines the course of phenomena, he is the ultimate standard of truth and error, and of right and wrong.

In analyzing our experience we actually find that the world is not a chaotic medley, but a law-ordained whole, a cosmos. There is progress and evolution; there is right and wrong; there is truth and error; there is goodness and evil, and whatever that factor may be which constitutes the world-order, which determines the nature of truth, of justice, of right and of goodness mankind call God. This is ultimately the nucleus of the God-conception and this God is most assuredly an undeniable presence in the world, and in investigating the nature of this presence we find that the laws of nature are part and parcel of God, and so are all the laws and rules and theorems which we construct in the purely formal sciences, in mathematics, mechanics and also in their applications ultimately in the rules of conduct and the ideals of moral behavior.

The God-conception of orthodox Christianity, of Mohammedanism, of the Jews and of theistic religions in general appears from this point of view as a mere mythology which, under the allegory of a personification, foreshadows the true God of science, and we

understand that as astrology changed into astronomy, the old theology will have to change into a newer more scientific and truer conception of God, into theonomy.[4]

The nature of God is ultimately order. The term law is not correct because the laws of nature are not arbitrary ukases of a monarch but intrinsic uniformities. They are necessary because they cannot be otherwise, and in order to avoid the misleading word "law" we describe it by the Greek word *nomos,* meaning norm; for God is neither the subjectivity of the world not its objectivity although we must assume energy and substance to be eternal and if they are eternal their subjectivity or the potentiality of developing feeling and mind must also be uncreated and uncreatable. But these ultimate cosmic elements are not God. They are, as we may say, merely material for creating a world. That which constitutes the divinity of life and the cosmos is that norm which governs the world, which makes it possible that rational beings originate, that there is a definite direction in the world of purely mechanical phenomena, that thinking beings can set themselves purposes and pursue them, and finally that moral endeavor appears in the struggle for existence. In a word, God is normative and we may call this conception of God nomotheism, and this is the reason we would prefer to call its systematic and scientific investigation no longer theology but *theonomy.*

As to the question of the justice of God Dr. Hall says: "Consider the question 'Is God just?' By justice is meant equality of conditions and opportunities; or equal results for equal efforts of different individuals. As so defined justice is conspicuous by its absence from the universe. Paul claims that one vessel is made for honor, another for dishonor; and the inequality of conditions among men is patent. In the field of energy a very slight factor often makes the difference between intense action and almost no action. In matter, too, there is endless diversity of relation. And no two portions of either space or time are similarly related to the rest of the universe. Hence justice does not belong to the essence of the universe."

Dr. Hall's conception of justice still reflects his conception of an individual God-being who creates his creatures as the potter makes vessels, using them arbitrarily for different purposes. The scientific conception of creation shows that creatures develop by forming their characters as they react upon their surroundings.

[4] See the author's book *God, An Inquiry and a Solution,* pp. 124-128.

In this sense creatures are what they want to be, and their fate is according to their deeds, which implies that intrinsically considered the justice pervading the universe is identical with the law of cause and effect. This kind of justice is not external like the idea of man's sense of justice, apportioning awards in agreement with merit and punishments with evil doing; divine justice is an intrinsic justice. A creature (or, generally, a thing) is exactly what it has become through its own actions. Its merit consists in being what it is, not what it receives. A diamond possesses qualities which distinguish it to its own credit from other combinations of carbon such as coal and graphite, and we must not seek justice in the price for which here or there a diamond may be bought. In the same way the reward of a noble sacrifice does not consist in the recognition it finds in the eyes of the world and still less in the remuneration it receives. Rewards cannot be measured in dollars and cents and true justice is the superiority of intrinsic worth.

In our opinion Dr. Hall's conception of God is an aberration. It identifies God with evolution. He says: "The idea of an omnipotent and absolutely perfect God cannot be reconciled with the imperfections of the universe as we know it. But an evolving God is in harmony with all the facts we know, and cuts the knot of many an unsolved problem. This idea of evolution as an essential character of God is not easy to grasp fully. It contradicts the common view of God as unchangeable or as the Absolute. The whole known universe is in the march of evolution. Its essence is therefore evolving. Its plan is being formed, its aims are more clearly defined now than ever before, its consciousness clearer and more extensive." Further down Dr. Hall says: "In the evolutionary sense, God is not wholly good, but is becoming good."

Dr. Hall's God is not the ultimate norm of the cosmos, but its manifestation. We may very well call this tendency of evolution God, but we must bear in mind that this God is a definite and concrete interrelation of all the facts of existence in successive stages. It is not the ultimate divine norm, it is its application, and in Christianity this idea corresponds to the idea of God as the Holy Ghost through whom the God-man or Christ, or Buddha, or whatever we may call God incarnate, is born into the real world of actuality.[5]

Our God-conception as the ultimate norm of existence is based

[5] For further details of this conception which underlies the doctrine of the trinity, see the author's *Personality*, pp. 46-60.

on very radical arguments for not even the atheist will seriously object to it. Nevertheless it is quite conservative and is in perfect agreement with traditional orthodoxy. This God is as supernatural as the God of the Old Testament, for God as the norm of the world would exist even if the world did not exist. In this sense God is above nature. He is truly and in the literal sense of the word supernatural. This God-conception is not the old pantheism and is very different from the common God-conception of liberal Christians. This God is not a person in the sense of an individual being and yet this God is not impersonal in the sense of having nothing to do with personality. This God is more personal than any person of human type for he is the prototype of personality; he is superpersonal. His dispensation as the ultimate condition of rationality and of moral aspiration makes it possible that an animal can develop into a personality. The appearance of personality in the purely physical world as it blossoms forth from animal life is due to him—indeed it is a revelation of his inmost being. Our habit of speaking of God as "he" not "it" is due to our need of using the most dignified expression for that power which deserves our highest reverence, for it is understood that as God is not an individual being but a universal norm, he is neither man nor woman, he is not a concrete individual, but the efficient norm which dominates the entire cosmos and also every phenomenon—the course of the stars and of the motes circling in every atom obedient to the laws of motion. We must not speak of the blind laws of motion, for though they are not conscious in the sense of human consciousness, though they do not argue according to the modes of deductive logic after the custom of human reason, they are not to be called blind as is so often done; they are not irrational for they possess definiteness and impart to existence a definite character, and it is this character, the character of God, which gives sense and meaning to the whole creation.

EDITOR.

A CORRECTION AND SOME REMARKS.

In the first place I must make a correction to the story in the third paragraph on page 151 of my article in *The Monist* for January, 1912. Mr. Russell tells me that the original of the story is that some of his hearers were disappointed that after a whole term's lecturing on the principles of mathematics Mr. Russell had never proved the elementary rule of algebra that "Minus into minus gives

plus." So Mr. Russell came back in the long vacation simply to finish the lectures by a proof of that important theorem.

Again, on page 153 of my article, I indicated an early statement of Russell's contradiction. Mr. Russell has informed me that he wrote the article referred to in January and found his contradiction in June. In January he had only found that there must be *something* wrong; for Cantor's proof would show that there is a greater transfinite cardinal number than the number of all entities.

The remarks I have to make are on the subject of the misrepresentation of the tendencies of the work of Frege, Peano, and Russell. I have tried to show this, in one case, in the article to which I have just referred; and, in another way, a misrepresentation is shown in that article of Poincaré's of which a part has been translated in *The Monist* for April 1912. What seems to me the principal thing in modern developments of mathematical logic is an emphasis on the fact that in mathematical arguments, we are concerned not with propositions but with what Russell has called *propositional functions.* Thus, the statement "x is a man" is the expression of a propositional function; whereas when the x is given some fixed denotation like "Socrates," the propositional function gives rise to a proposition. The sign x is analogous to what is called the *argument-sign* in the expression of a mathematical function, and there is, as Frege expressed it, *incompleteness* about a function,—"the x" only holding a place open into which various signs representing constants, like Socrates or Chicago, may be put. The result of putting any one of these in the place of x is a proposition which is either eternally true or eternally false, and not sometimes true or sometimes false, as one is prone—rather inaccurately— to say of a propositional function. Now, in most ordinary discourse and in mathematics we state implications between propositional functions and not between propositions. Thus, such a statement as: "When it rains in London, Mr. A. of New York will turn his trousers up" is obviously an implication between two propositional functions; each function depending, as we would say in mathematics, on a variable representing the time. In mathematics, we may show how implication between propositional functions occurs by an illustration due to Russell[1]: "The fifth proposition of Euclid follows from the fourth; if the fourth is true, so is the fifth, while if the fifth is false, so is the fourth. This is a case of material implication [Russell called by the name of "material implication" implication between

[1] *The Principles of Mathematics,* 1903, p. 14.

propositions and by the name of "formal implication" implication between propositional functions], for both propositions are absolute constants, not dependent for their meaning upon the assigning of a value to a variable. But each of them *states* a formal implication. The fourth states that if x and y be triangles fulfilling certain conditions, then x and y be triangles fulfilling certain other conditions, and that this implication holds for all values of x and y; and the fifth states that, if x is an isosceles triangle, x has the angles at the base equal. The formal implication involved in each of these two propositions is quite a different thing from the material implication holding between propositions as holds; both notions are required in the propositional calculus, but it is the study of material implication which specially distinguishes this subject, for formal implication occurs throughout the whole of mathematics."

It is, perhaps, the greatest merit of Peano that he distinctly perceived and emphasized this important fact. Indeed, he rather unduly neglected propositions in his calculus, and, when he spoke of "propositions," he really meant what we, following Russell, call "propositional functions." The great difficulty that always stood in the way of the application of logic to mathematics was the fact that in traditional logic the two kinds of implication were certainly confused together, but the only kind of implication explicitly considered was a material implication.

When Dr. Carus emphasizes that the notion of "anyness" is fundamental in mathematics, he seems to be in essential agreement with Peano and Russell that the terms which stand on either side of an implication in mathematics are propositional functions and not propositions. I do not know whether one ought to go farther, and say that Dr. Carus intended by this phrase that the region of the variable in mathematics is unrestricted, and definitions are to be made and implications stated without hypotheses restricting the variable to a certain class. If so, the phrase would indicate an advance beyond the position of Peano to a closer agreement with the present views of Frege and Russell.

It is much to be regretted, accordingly, that the article by Mr. Russell[2] of which I have given some account in *The Monist* for January, 1912, should have been marred by misprints or other alterations of Mr. Russell's phrases, and thus have given a wrong impression to Dr. Carus. The fact is that Mr. Russell's article was written with that combination of seriousness and wit to which he

[2] Published in the *International Monthly*, 1901.

has accustomed us; the alterations seemed to do their best to make part of his article either frivolous or pompous.

PHILIP E. B. JOURDAIN.

CAMBRIDGE, ENGLAND.

THE MECHANISTIC PROBLEM.

This number of *The Monist* contains much valuable material on the pro and con of the mechanistic problem. The dualist side is maintained by Dr. William Benjamin Smith of Tulane University who formulates the question with great precision and makes an eloquent plea for the idea that the present is governed by the future and that man is not mechanically pushed but that his ideals pull him upward and on. Dr. Jacques Loeb of the Rockefeller Institute, on the other hand, represents the extreme naturalists who scent the old-fashioned teleology not only in theology but also in all philosophical aspirations. His view is supported, in the name of the late Clémence Royer and her followers, by M. Aristides Pratelle. Professor Loeb goes so far as to suggest that ethicists and educators of the future will have to find their medicine for curing the moral ills of mankind in the storehouse of biochemistry, a proposition which is well brought out by one of his admirers, Dr. Leonard Keene Hirshberg.[1]

The editor of *The Monist* deems both positions wrongly taken, or rather thinks that both are one-sided presentations of certain truths which if properly stated form no contradiction but present a contrast of the greatest importance.

The contrast between these two views may be traced through the history of philosophy. There have always been thinkers on either side, and both views have been upheld with great vigor and have been important factors in the development of mankind. We intend to publish an editorial on the subject in a forthcoming number and wish here merely to characterize briefly our view.

We believe that the mechanistic theory is absolutely right in so far as it claims that the mechanical principle has to be applied to all events, processes and happenings without any exception, for necessarily all movements must take place according to mechanical laws—even the motions of the brain can form no exception; but we insist that mechanical laws apply only to mechanics, which truth

[1] See the review of Professor Loeb's recent book, *The Mechanistic Conception of Life*, pp. 152-158, especially 154 ff.

may be expressed in the tautology that all motions are subject to the laws of motion.

Nevertheless, there are features in the world which are not motions, and it is wrong to expect an explanation of their nature and significance from the laws of motion. This is especially true of the interpretation of forms in the actual world and of the products of formal combinations in the realm of purely formal thought. Among other things we have to deal with logic and geometry. How can we deduce a logical syllogism from mechanistic principles if the interconnection of logical ideas is purely logical; and, further, according to what mechanistic principle can we explain the interrelation of a triangle by laws of motion? The reverse is true: we explain mechanics from, and formulate the laws of mechanics according to, the theorems of geometry, and the mechanics of thinking find their explanation in the more general laws of logic. To construct a triangle we must draw lines but from the act of drawing lines we cannot prove the interrelation of the parts of the triangle.

Motion is a generalization of all changes of place that occur in our own bodies and in the entire objective world around us. But in making this generalization we omit one highly important feature of our experience, namely, the feeling which is the ultimate condition of our entire psychic and mental life.

We do not believe that there are feelings in themselves; we accept the theory of the so-called parallelism. We believe that feelings are the inner side of physical occurrences; feelings are the subjective aspect of certain motions which take place in organisms.

We consider it a fact that the main feature of mental life consists in purpose. Man is a purposive being; he follows the lead of ideals, of aspirations, of aims which he pursues, and one of the main problems of philosophy is to explain how such a thing as purpose can originate in a world where all events, all happenings, all motions, take place according to mechanistic principles.

The reader will notice that we limit the application of the mechanistic principle to motions and we state that all happenings, all events, all occurrences, all processes, all acts of living beings, including the acts of man, are motions, or changes, or to be quite unequivocal, they are somehow changes of place. But those features of life which are not motions play also an important part. They affect the mechanical processes of life and in them the non-mechanical lies hidden.

Thinking, that is to say, the act of thinking, in its physiological

aspect as a cerebral motion is absolutely mechanical. Every idea is a definite brain structure and in its action it is as much subject to the law of mechanics as is the falling stone. But is the meaning of the idea mechanical? Here lies the problem.

Not finding room in this number for the exposition of this important subject, we must be satisfied here to let the representatives of both sides have their say and for ourselves will only reserve the right to discuss the problem in the near future. P. C.

WRONG GENERALIZATIONS IN PHILOSOPHY.

SCHOPENHAUER AND FREUD.

One common source of error in philosophy has been the principle of generalization wrongly applied. For the sake of explaining phenomena we must understand that a higher development produces new conditions which are absolutely absent in the lower strata of life. Now it happens that some philosophers take features typical of the highest and most complicated forms of existence and generalize them to explain the nature of lower forms. Others do the reverse. They generalize the lowest forms and explain all higher features as mere repetitions of simpler modes of activity.

As a typical instance of the wrong generalization of the higher forms of life over all lower manifestations, we refer to Schopenhauer and his theory of the will. When the stone falls the naturalist calls it gravity, and we ask with surprise what is the impulse that makes the stone fall. Schopenhauer answers, It is the will. The stone wills to fall to the center of the earth according to the Newtonian law and that explains the phenomena of gravitation. Goethe makes Mephistopheles in his rôle of professor say to the student that man is pleased to hear words:

> "With words 't is excellent disputing;
> Systems to words 't is easy suiting;
> On words 't is excellent believing;
> No word can ever lose a jot from thieving."

The opposite course, but in principle the same method, is followed by Freud who bases his psychology upon the erotic instinct. The higher life of man is enfolded in a rich complexity of noble and sometimes highly altruistic tendences, in the love of parents, devotion of children, love of country, of ideals and many aspirations. Observers of life stand in awe before the wonders of

the human mind, the sacrifices brought without any reference to selfish motives, and we ask how is such nobility of character possible. Then comes the psychologist who has observed the deep-seated erotic passion and shows that ultimately all these wonderful phenomena are to be explained as modifications of the sexual instinct.

The Freudian theory is practically the same mistake that Schopenhauer commits, only in its reverse aspect. Freud generalizes the lower tendency so as to cover the highest efflorescence of mental life. The general public given to being satisfied with mere words is pleased to have an answer. A word takes the place of an explanation and the philosophical demand is supplied, at least for a while.

Freud's theory has become quite prominent but we predict that it will not last. In his various investigations he has made many valuable comments but on the whole his explanations do not explain; they leave the problem where it was before. They are born of the need of a monistic explanation indicating that all phenomena are to be classified under one heading, and the success of the theory will last as long as the personality of the master holds the attention of the reading public. P. C.

BOOK REVIEWS AND NOTES.

THE MECHANISTIC CONCEPTION OF LIFE. By *Jacques Loeb, M. D., Ph. D, Sc. D.* Chicago: University Press, 1912.. Pp. 232. Price $1.50 net.

The ideal of science is to establish on a firm basis the mechanistic conception of life, and Prof. Jacques Loeb has been one of the most enthusiastic and efficient workers in this line of investigation. He has succeeded in performing a number of experiments whereby he has proved that the interference with the organs of animalcules produces effects analogous to the interference, and that certain actions depend on definite constitutions which he classifies as their tropisms, just as much as the sizes of wheels and cranks in machinery determine the movements of an engine. The book before us contains a number of articles which were used on different occasions either as lectures or as essays, and all of them characterize the tendency "to analyze life from a purely physico-chemical view-point." The first chapter is an English translation of Professor Loeb's address at the first international congress of monists at Hamburg, and may be considered as a general program of the mechanistic conception. The difficulty of this view comes in when we come to the properly psychical phenomena of the higher animals, especially man, and here Professor Loeb also insists on the principle that "all life phenomena can be unequivocally explained in physico-chemical terms," and he continues that even "our social and ethical life will have to be put on a scientific basis, and our rules of conduct must be brought in harmony with the results of scientific biology," and by "scientific" Professor Loeb understands physico-chemical.

Professor Loeb selects as most significant instances the tropisms of various animals. Referring to the specific life processes, he says that "if we can convince ourselves that these processes can be explained physico-chemically we may safely expect the same of such processes for which there exist *a priori* analogies in inanimate nature, as, e. g., for absorption and secretion."

Professor Loeb says: "The contents of life from the cradle to the bier are wishes and hopes, efforts and struggles, and unfortunately also disappointments and suffering. And this inner life should be amenable to a physico-chemical analysis? In spite of the gulf which separates us to-day from such an aim I believe that it is attainable. As long as a life phenomenon has not yet found a physico-chemical explanation it usually appears inexplicable. If the veil is once lifted we are always surprised that we did not guess from the first what was behind it.

"That in the case of our inner life a physico-chemical explanation is not beyond the realm of possibility is proved by the fact that it is already possible for us to explain cases of simple manifestations of animal instinct and will on

a physico-chemical basis; namely, the phenomena which I have discussed in former papers under the name of animal tropisms. As the most simple example we may mention the tendency of certain animals to fly or creep to the light."

This principle applied to ethics is explained thus: "If our existence is based on the play of blind forces and only a matter of chance; if we ourselves are only chemical mechanisms—how can there be an ethics for us? The answer is, that our instincts are the root of our ethics and that the instincts are just as hereditary as is the form of our body. We eat, drink, and reproduce not because mankind has reached an agreement that this is desirable, but because, machine-like, we are compelled to do so. We are active, because we are compelled to be so by processes in our central nervous system; and as long as human beings are not economic slaves the instinct of successful work or of workmanship determines the direction of their action. The mother loves and cares for her children, not because metaphysicians had the idea that this was desirable, but because the instinct of taking care of the young is inherited just as distinctly as the morphological characters of the female body. We seek and enjoy the fellowship of human beings because hereditary conditions compel us to do so. We struggle for justice and truth since we are instinctively compelled to see our fellow beings happy. Economic, social, and political conditions or ignorance and superstition may warp and inhibit the inherited instincts and thus create a civilization with a faulty or low development of ethics. Individual mutants may arise in which one or the other desirable instinct is lost, just as individual mutants without pigment may arise in animals; and the offspring of such mutants may, if numerous enough, lower the ethical status of a community. Not only is the mechanistic conception of life compatible with ethics: it seems the only conception of life which can lead to an understanding of the source of ethics."

These quotations are sufficient to characterize the tendency of the book. In the field of comparative physiology the unraveling of the mechanism of associative memory is the great discovery to be made in the realm of physiological morphology. While Professor Loeb has done good experimental work, he points out that there is a higher aim than to discover the laws of organization of the tissues, for we should endeavor to form new combinations from elements of living nature, just as the physicists and chemists form new combinations from the elements of living substance. In the field of fertilization much has been done of late which may almost be called sensational, for the process of fecundation is no better understood than before, and strange to say parthenogenesis has become an established fact, for we can experimentally prove that an egg may be fertilized by different stimuli without the introduction of a sperm. A special article is devoted to a discussion of the rôle which salts play in the preservation of life. At the end of the book Professor Loeb points out that the insight gained into the mutations that take place and the laws of heredity—the former represented by the labors of De Vries, the latter by the laws of Mendel—place before the experimental biologist the difficult task of producing favorable mutations by physico-chemical means. Nobody has thus far succeeded in this, although nothing warrants us to take it for granted that the task is beyond the power of science.

With regard to Professor Loeb's experiments directed towards the dis-

covery of mechanical causes of will, Dr. Leonard Keene Hirshberg sends the following detailed review:

"Professor Jacques Loeb, M.D., Ph.D., Sc.D., and Member of the Rockefeller Institute for Medical Research, has applied scientific methods of the biological laboratory to throw light upon the great ethical problem of free will. His researches are startling to say the least. Like the recent prophecy of Prof. A. E. Schaeffer, the great English physiologist, his report will bring down the condemnation of all creeds and churches upon his work.

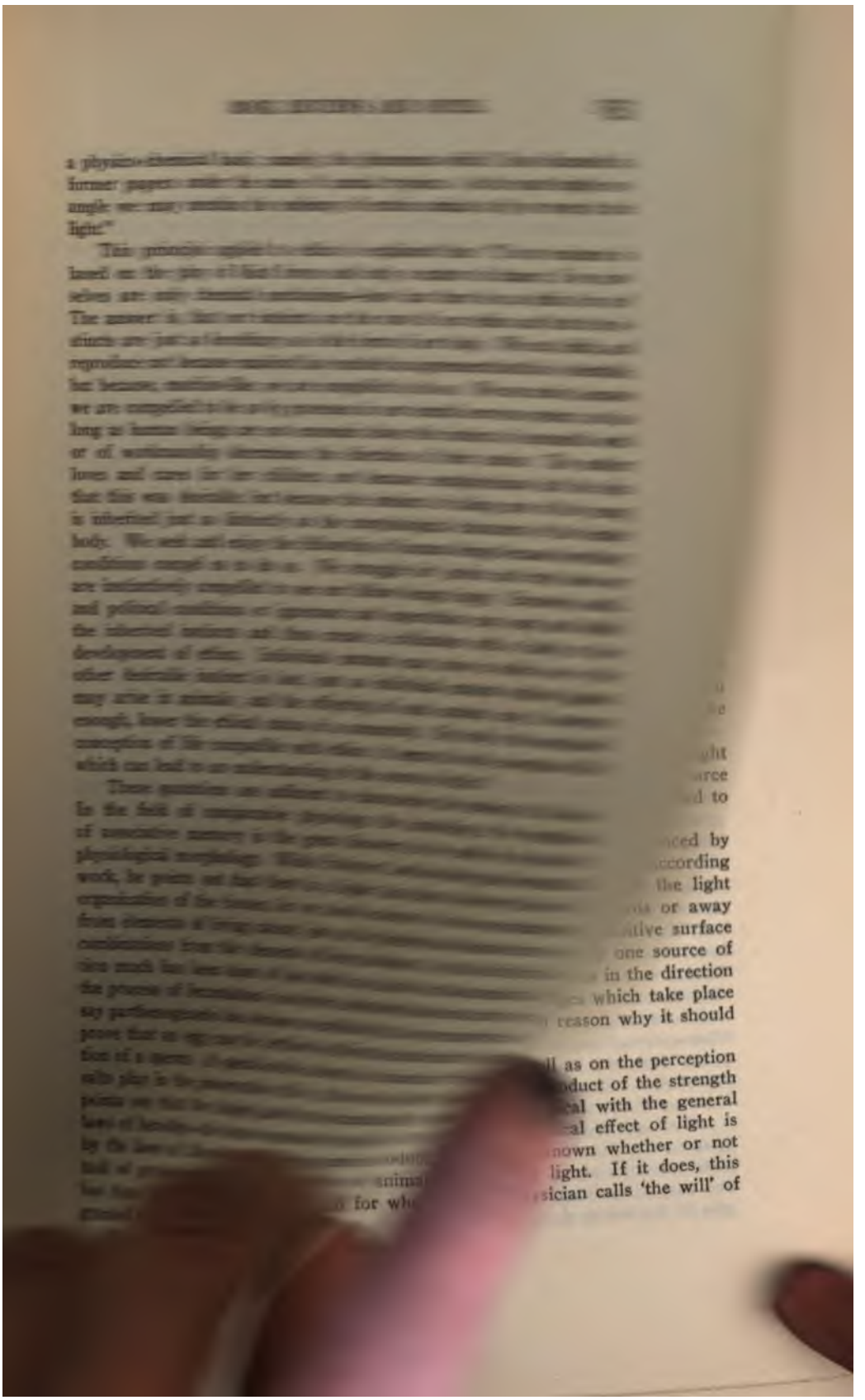
"Although most of us will not at this time agree with Professor Loeb, although his deterministic conception of life is revolutionary in its discovered facts, at this moment we lack the laboratory and experimental data to deny Dr. Loeb's conclusions. Therefore in a perfectly fair spirit, without agreeing with or disputing his discovery, I shall present here with all technical matters omitted, the mass of newly exposed facts opened up to the world by the genius of this great savant.

"Perhaps not since Loewoenhoeck first observed the cell, since Jenner gave us a means of preventing smallpox, Koch and Pasteur proved bacteria to be concerned with diseases, Sir A. E. Wright exposed the mechanism of vaccination, and Ross with Manson proved the mosquito guilty of transmitting malaria, has there been such a startling announcement from the laboratories of the experimental sciences as this one of Dr. Loeb. All the problems of sociology, commerce, creeds, religions, ethical practice, finance, and community effort hinge upon the verification or refutation of his discovery.

"Through the writings of Schopenhauer he became interested in the problem of will. When as a student he read Munk's investigations on the brain he believed that they might serve as a starting point for an experimental analysis of will. Munk stated that he had succeeded in proving that every memory-image in a dog's brain is localized in a particular cell or group of cells and that any one of these memory-images can be extirpated at desire. Five years of experiments with sections and slices of brain proved to Dr. Loeb beyond doubt that Munk had become the victim of an error and that the method of brain operations may give data concerning the path of nerves in the central nervous system, but that it teaches little about the activities of brain processes.

"A better opportunity seemed to offer itself in the study of the comparative psychology of the lower animals in which the machinery for memory is developed but slightly or not at all. It seemed to him that some day it must become possible to discover the physico-chemical laws underlying the apparently random movements of such animals; and that the word 'animal will' was only the expression of our ignorance of the forces which prescribe to animals the direction of their apparently spontaneous movements just as certainly as gravity prescribes the movements of the planets.

"The scientific solution of the problem of will seemed then to consist in finding the forces which determine the movements of animals, and in discovering the laws according to which these forces act. Experimentally, the solution of the problem of will must take the form of forcing any number of individuals of a given species to move in a definite direction by means of their locomotor apparatus. Only if we succeed in this have we the right to assume that we know the force which under certain conditions seems to everybody



"Many animals show no 'heliotropism' or light influence at all; many show only a slight response to light, while others show it in a degree as pronounced as do winged plant lice. The problem therefore presented itself to Professor Loeb of artificially producing heliotropism, or response of a creature to the influence of light, in animals which, under natural conditions, show no heliotropism. If small crabs of a fresh-water pond or lake are taken with a net at noontime or in the afternoon and placed in an aquarium which is illuminated from one side only, it is often found that these animals move about in the vessel pretty much at random and distribute themselves irregularly. Some seem to move toward the source of light, others in the opposite direction, and the majority perhaps pay no attention to the light.

"This condition changes instantly if we add to the water some acid, preferably carbonic acid, which easily penetrates the cells of the animal. All the individuals become active and approach the light. They move in as straight a line as the imperfection of their swimming movements permits, toward the source of light, and remain there closely crowded together on the illuminated side of the vessel. If the vessel is reversed they go directly back again to the lighted side of the vessel. Every other acid acts like carbonic acid, and alcohol acts in the same manner, only more weakly and much more slowly. Animals which were previously indifferent to light become, under carbonic acid treatment, complete slaves of the light.

"The acid acts as a sensitizer. The light produces chemical changes—for instance, oxidation—on the surface of the animal, especially in the eye. The mass of substance which is acted upon by the light is often relatively small, so that even when the light strikes the crab on one side only, the difference in the chemical changes on the two sides of the body remains still too small to call for a difference in tension or action in the muscles of the two sides of the body, sufficient to turn the animal toward the source of light. But if an acid is added, this could act increasing the active parts of the substance which undergoes a chemical change. Thus the acid makes the animal more strongly attracted towards the light by increasing the active mass of the sensitive substance on its body.

"Some authors have, it seems, worked only with animals which were not pronouncedly 'heliotropic' or influenced by light and whose photo-sensitiveness wavered about the threshold of stimulation. Professor Loeb believed that observations upon animals which are not sufficiently photo-sensitive have caused many writers to assert that animals do not place themselves directly in the line of the rays of light, but that they first have to learn the right direction to go. Every striking experiment contradicts this assertion. The larvæ of a small marine animal develop entirely in the dark. If the eggs filled with mature larvæ are placed in a watch crystal filled with sea-water in the dark, the larvæ emerge at once to the side of the crystal nearest to the window. They were therefore pronouncedly attracted by light before they came under the influence of the light, literally before they are born.

"In experiments with winged plant-lice, Professor Loeb often found that after having gone through the heliotropic reactions a few times they react much more quickly to light than at the beginning. This might be interpreted as a case of 'learning.' In so far as it is not a case of lessening of the stickiness of the feet or the removal of some other purely mechanical factor which

retards the rate of movement, it may be brought about by the carbonic or lactic acids produced through the muscular activity.

"It is a well-known fact that during sexual maturity special substances are formed which influence various organs. For instance, Professor Loeb has found that the substances which are set free by the bursting of an egg causes special sensitiveness in the non-pregnant animal.

"It is a common phenomenon that animals in certain larval stages are positively attracted by light, while in others they are not sensitive to light or are even negatively repelled by it. This change in the heliotropic sensitiveness produced by certain chemical products in the animal body, is of great biological significance.

"The fact that ants and bees become positively attracted to a source of illumination at the time of sexual maturity plays an important rôle in the vital economy of these creatures. As is well known the mating of these insects takes place during the so-called nuptial flight. Professor Loeb found that among the male and female ants of a nest the sensitiveness to light increases steadily up to the time of the nuptial flight and that the direction of their flight follows the direction of the rays of the sun. He gained the impression that this nuptial flight is merely the consequence of a very highly developed heliotropic or light sensitiveness. The following is an experiment which shows that the case is similar among the bees. The bees were ready to swarm out of the opening of the box used for the experiment when the dark covering of the box was removed so that the light entered it from above. The sensitiveness of the animals to light was so great that they crept upward within the box, following the direction of the light rays, and were not able to make the nuptial flight. Thus, according to these observations the bees at the time of the nuptial flight are *positively heliotropic* machines.

"The attempt has been made to prove that organisms are attuned to a certain intensity of light and so regulate their heliotropism, that they invariably reach that intensity of light which is best suited to their well-being Professor Loeb believed that this was a suggestion forced upon the investigators by the extreme application of the theory of natural selection. He made experiments upon a large number of animals, but, with a clear arrangement of the physical conditions of the experiment, he has never found a single indication of such an adaptation.

"Animals are in general symmetrically built, and the muscles of the right and left sides of the body usually act symmetrically. There are animals, however, which move sideways, for instance, certain crabs like the fiddler crab. It was also found out that they go sideways toward the light. Professor Loeb says that in the fiddler crab there is an entirely different connection between the retina and the locomotor muscles from that in other crabs, and that there is a special peculiarity in regard to the function of the two eyes whereby they do not act like symmetrical elements.

"These facts may suffice to explain his point of view. To him it was a question of making the fact of psychology accessible to analysis by means of physical chemistry. In this way it is already possible to reduce a set of movements, namely the influence of light, to simple mechanical relations. Many animals, because their body structure is not only anatomically, but also

chemically symmetrical, are obliged to direct their bodies in a certain way in relation to certain centers of force, as, for instance, the course of light, an electric current, the center of gravity of the earth, or some chemical substances. This direction is automatically regulated according to the law of size and shape. The application of this law to this set of influences is thus made possible. Professor Loeb considers it unnecessary to give up the term 'comparative psychology,' but is of the opinion that the facts and discoveries of animal psychology, under the influence of the experiments of himself and others, will be different from the contents of speculative psychology. But he also believes that the further development of this subject will fall more to the lot of biologists trained in physical chemistry than to the specialists in psychology or zoology, for it is in general hardly to be expected that zoologists and psychologists who lack a physico-chemical training will feel attracted to the subject of the influence of light and other external things in an animal's surroundings, and a study of their effects.

"Professor Loeb says concerning the possible application of these investigations that the investigations of the conditions which produce them may be of importance for the study of insanity in man. If by means of an acid we call forth in an animal otherwise indifferent to light an effect which drives it irresistibly into a flame; if the same thing can be brought about by means of an extract of the reproductive glands he believes a group of facts have been given within which the analogies necessary for a study of insanity can be called forth experimentally and can then be investigated. Says Professor Loeb: 'These experiments may also attain a similar value for morality and ethics. The highest manifestation of ethics, namely, the condition that human beings are willing to sacrifice their lives for an idea, is comprehensible neither from the utilitarian standpoint nor from that of the categorical imperative or the "still small voice." It might be possible that under the influence of certain ideas chemical changes, for instance, internal secretions within the body, are produced which increase the sensitiveness to certain stimuli to such an unusual degree that such people become slaves to certain stimuli just as crabs become slaves to the light when carbon dioxide is added to the water. Since Pawlow and his pupils have succeeded in causing the secretion of saliva in the dog by means of optic and acoustic signals, it no longer seems strange to us that what the philosopher terms an "idea" is a process which can cause chemical changes in the body.'"

DIE MECHANIK IN IHRER ENTWICKLUNG. Historisch-kritisch dargestellt von *Dr. Ernst Mach.* Leipsic: Brockhaus, 1912.

It may well be a source of gratification to Professor Mach that forty years after the first utterance of his favorite principles and almost thirty years after their appearance in the more comprehensive form of his *Mechanik,* there comes a demand for a seventh edition of this work. In his preface to this revised and enlarged edition the venerable scientist relates something of the history of the book, and the reception accorded it and the principles for which it stands. When the author's ideas were first promulgated they not only met with little recognition and encouragement but with general opposition. When Kirchhoff published his views two years later Mach was accused of having

misunderstood him whereas he "must beg to disclaim this prophetic misunderstanding of a statement before it was made, on the ground that it does not accord with his prophetic gift and intellectual powers." Nevertheless the book has survived not only a seventh edition but also translation in the English, French, Italian and Russian languages. Mach considers that his views were most popular in the latter part of the last century when the empirical side of mechanics had been too much neglected. Now the Kantian traditions are again at the front so that there is once more a demand for an *a priori* foundation of mechanics. Mach has made it clear that both the logical and empirical sides of the subject demand investigation even though his own work leans to the empirical side.

This edition is somewhat more homogeneous than its predecessors. Much polemical discussion which has no interest for to-day has been omitted and much new material has been added, though the character of the book remains the same. Mach says: "With regard to the conceptual monstrosities of absolute space and absolute time I can take nothing back. I have shown only more clearly than before that although Newton had much to say about these things yet he made no serious application of them. His fifth corollary contains the only practically usable inertial system, and it is probably only an approximation." ρ

THE AMERICAN PHILOSOPHY PRAGMATISM. By *A. v. C. P. Huizinga.* Boston: Sherman, French & Co., 1911. Pp. 64.

Rev. A. v. C. P. Huizinga in sending us his criticism of pragmatism refers to it as "the criticism of a Calvinist." He declares that the latest works of Professor James, the "gifted and scholarly exponent" of pragmatism, "plainly bear witness to the fact that the real point at issue is a denial of the supernatural, a discarding of the notion of being, involving a static element. It is a revolt against all tradition, authority and unity; it sets itself against all regulative norms and law."

The author concludes his preface with these words: "In sending forth this essay I hope that it may contribute to a more earnest consideration of life's issues, from *Weltanschauung* to *Gottanschauung*, that the spirit of truth may lead us into all truth. May many by faith learn Jesus as the truth, and so learn to consecrate themselves to the truth as it is in Jesus!"

In criticism of Mr. Huizinga's view we would suggest that Professor James is not quite so systematic and concise as he appears under the critical consideration of Mr. Huizinga. It is true that Professor James defies all authority as systematic unity in its norm and law, but he never denied the supernatural. On the contrary he found in the irregularity of his cosmic conception a loop-hole for any kind of supernaturalism, not exactly the theistic conception of it as purely demonistic possibilities which would revive many of the old superstitions which flourished even as early as being prior to Christian monotheism. κ

DIE WELTANSCHAUUNG ROBERTO ARDIGO'S. Von *Dr. J. Bluwstein.* Leipsic: Eckardt, 1911. Pp. 122. Price 1.50 m.

Roberto Ardigo is an Italian professor whose philosophy is little known

outside of Italy. In Germany he has recently found an interpreter in Dr. J. Bluwstein, who has brought Ardigos' works before the philosophical department of the University of Leipsic in a course of lectures. Ardigo was born in 1828 and is still pursuing active intellectual labors. His biographer refers to his course of life as a unique one, from that of a Catholic priest to an apostle of an unreligious world-conception. He calls his philosophy "positivism" and bases it on "the fact" as its fundamental concept. The first chapter of Dr. Bluwstein's work contains a presentation of Ardigo's positivism; the second is a characterization of that philosophy; the third treats of the scientific spirit according to Ardigo's world-conception; and the fourth is devoted to the results. A fifth chapter is added as an appendix containing complementary notes on the whole. ρ

LA SOCIÉTÉ ET L'ORDRE JURIDIQUE. Par *Alessandro Levi*. Paris: Octave Doin, 1911. Pp. 396. Price 5 fr.

This volume is one number of the sociological library (edited by Gaston Richard) which forms one of the forty parts of the *Encyclopédie scientifique*. This encyclopedia is to comprise about a thousand scientific monographs and books and is intended to equal or surpass all encyclopedic works of other countries by its closely scientific character and the clearness of its expositions. The author of the volume before us is professor of the philosophy of law at the University of Ferrara and he here presents to the world an investigation of the bases of juridical order which he introduces by a chapter on the place of the philosophy of law in the logic of the sciences and in social life. He then discusses in turn personality in connection with the rise of the idea of law; nature; society and juridical procedure; presumptions and juridical fiction; the objective and subjective sides of law and the idea of law compared with that of justice. The book is furnished with an excellent bibliography covering almost one hundred and fifty names, besides a thorough alphabetical index of authors and subjects. ρ

WELTBEGRIFF UND ERKENNTNISBEGRIFF. Von *Viktor Kraft*. Leipsic: Barth, 1912. Pp. 232. Price 5 marks.

This little book is an investigation of the nature of the conceptions of the world and of cognition by epistemological methods. The author Dr. Viktor Kraft has been an adherent of idealism, but has passed over to a realistic interpretation of the world. The difficulties of all different idealistic conceptions have after a careful investigation led him to the conclusion that practically the subjective, the objective, the transcendental idealism are of the same type as the metaphysical idealism of a century ago, and that their latest consequence must be a subjective idealism. But in turning around to try the realistic interpretation of nature, which the author believes must be openly and frankly confessed, he comes to the conclusion that realism involves the dualism of the physical and psychological; hence that it is the duty of philosophy to investigate critically the problems which originate through the assumption of a dualistic realism. He endeavors to prove the objectivity of reality as one of the main demands of science, but in spite of his attempt to be just to all problems, we can not say that his arguments are convincing. κ

VOL. XXIII. APRIL, 1913. NO. 2

THE MONIST

THE RELATIVITY OF SPACE.[1]

I.

IT is impossible to represent to oneself empty space; all our efforts to imagine a pure space, from which the changing images of material objects would be excluded, can result only in a representation where vividly colored surfaces, for example, are replaced by lines of faint coloration, and we cannot go to the very end in this way without all vanishing and terminating in nothingness.

Thence comes the irreducible relativity of space.

Whoever speaks of absolute space uses a meaningless phrase. This is a truth long proclaimed by all who have reflected upon the matter, but which we are too often led to forget.

I am at a definite point in Paris, the Place du Panthéon for instance, and I say, I shall come back *here* to-morrow." If I am asked, "Do you mean you will return to the same point of space?" I shall be tempted to answer, "Yes"; and yet I shall be wrong, since by to-morrow the earth will have journeyed hence carrying with it the Place du Panthéon, which will have traveled over more than 2 million kilometers. And if I tried to speak more precisely I should gain nothing, since our globe has run over these 2 million kilometers in its motion with relation to the sun, while the sun in its turn is displaced with reference to the Milky Way, while the Milky Way itself is doubtless in motion

[1] Translated by George Bruce Halsted.

without our being able to perceive its velocity. So that we are completely ignorant, and always shall be, of how much the Place du Panthéon is displaced in a day.

In sum, I meant to say: "To-morrow I shall see again the dome and the pediment of the Panthéon, and if there were no Panthéon my phrase would be meaningless and space would vanish."

This is one of the most commonplace forms of the principle of the relativity of space; but there is another, upon which Delbœuf has particularly insisted. Suppose that in the night all the dimensions of the universe become a thousand times greater; the world will have remained *similar* to itself, giving to the word *similitude* the same meaning as in Euclid, Book VI. Only what was a meter long will measure thenceforth a kilometer, what was a millimeter long will become a meter. The bed whereon I lie and my body itself will be enlarged in the same proportion. When I awake to-morrow morning, what sensation shall I feel in the presence of such an astounding transformation? I shall perceive nothing at all. The most precise measurements will be incapable of revealing to me anything of this immense convulsion, since the measures I use will have varied precisely in the same proportion as the objects I seek to measure. In reality, this convulsion exists only for those who reason as if space were absolute. If I for a moment have reasoned as they do, it is in order the better to bring out that their way of seeing implies contradiction. In fact it would be better to say that space being relative, nothing at all has happened, which is why we have perceived nothing.

Have we the right, therefore, to say that we know the distance between two points? No, since this distance could undergo enormous variations without our being able to perceive them, provided the other distances have varied in the same proportion. We have just seen that when I say,

"I shall be here to-morrow," this does not mean that to-morrow I shall be at the same point of space where I am to-day, but rather that to-morrow I shall be at the same distance from the Panthéon as to-day. And we see that this statement is no longer sufficient and that I should say: "To-morrow and to-day my distance from the Panthéon will be equal to the same number of times the height of my body."

But this is not all. I have supposed the dimensions of the world to vary, but that at least the world would always remains similar to itself. We might go much further, and one of the most astonishing theories of modern physics furnishes us the occasion.

According to Lorentz and Fitzgerald, all the bodies borne along in the motion of the earth undergo a deformation. This deformation is, in reality, very slight, since all dimensions parallel to the movement of the earth diminish by a hundred millionth, while the dimensions perpendicular to this movement are unchanged.

But it matters little that it is slight; that it exists suffices for the conclusion I am about to draw. Moreover, I have said it was slight, but in reality I know nothing about it; I have myself been victim of the tenacious illusion which makes us believe that we can conceive an absolute space; I have thought of the motion of the earth in its elliptic orbit around the sun, and I have allowed thirty kilometers as its velocity. But its real velocity (I mean, this time, not its absolute velocity, which is meaningless, but its velocity with relation to the ether) I do not know, and have no means of knowing it: It may be 10 or 100 times greater, and then the deformation will be 100 or 10,000 times more.

Can we show this deformation? Evidently not. Here is a cube with its edges 1 meter in length; in consequence of the earth's displacement it is deformed, the edge which is parallel to the motion becoming smaller, the others re-

maining unchanged. If I wish to assure myself of this by the aid of a meter measure, I shall first measure one of the edges perpendicular to the motion and shall find that my standard meter fits this edge exactly; and in fact neither of these two lengths is changed, since both are perpendicular to the motion. Then I wish to measure the other edge, that parallel to the motion; to do this I change the position of my meter and turn it so as to apply it to the edge. But since the meter has changed orientation and become parallel to the motion, it has undergone, in its turn, the deformation, so that though the edge be not exactly a meter long, it will fit exactly and I shall find out nothing.

You ask then of what use is the hypothesis of Lorentz and Fitzgerald if no experiment can make its verification possible? It is my exposition that has been incomplete. I have spoken only of measurements that can be made with a meter; but we can also measure a length by the time it takes light to traverse it, on condition that we suppose the velocity of light constant and independent of direction.

Lorentz could have accounted for the facts by supposing the velocity of light greater in the direction of the earth's motion than in the perpendicular direction. He preferred to suppose that the velocity is the same in these different directions, but that the bodies are smaller in the one than in the other.

If the wave surfaces of light had undergone the same deformations as the material bodies we should never have perceived the Lorentz-Fitzgerald deformation.

In either case it is not a question of absolute magnitude but of the measure of this magnitude by means of some instrument which may be a meter or the path traversed by light. It is only the relation of the magnitude to the instrument that we measure; and if this relation is altered, we have no way of knowing whether it is the magnitude

or the instrument which has changed. But what I wish to bring out is that in this deformation the world has not remained similar to itself; squares have become rectangles, circles ellipses, spheres ellipsoids. And yet we have no way of knowing whether this deformation is a real one. Evidently we might go much further. In place of the Lorentz-Fitzgerald deformation whose laws are particularly simple, we might imagine any deformation whatsoever. Bodies might be deformed according to any laws however complicated and we should never notice it provided all bodies without exception were deformed according to the same laws. In saying "all bodies without exception" I include of course our own body and the light rays emanating from different objects.

If we look at the world in one of those mirrors of complicated shape which deform objects in a bizarre way, the mutual relations of the different parts of this world would not be altered; if in fact two real objects touch, their images likewise seem to touch. Of course when we look in such a mirror we see indeed the deformation, but this is because the real world continues to exist alongside of its deformed image. Then, too, even if this real world were hidden from us, there is one thing that could not be hidden, and that is ourself; we could not cease to see, or at least to feel, our body and our limbs which have not been deformed and which continue to serve us as instruments of measure. But if we imagine our body itelf deformed in the same way as if seen in the mirror, these instruments of measure in their turn will fail us and the deformation will no longer be ascertainable.

Consider in the same way two worlds as images of one another. Each object P of the world A has a corresponding image P′ in the world B. The coordinates of this image P′ are determinate functions of those of the object P. Moreover they may be any functions whatsoever; I only sup-

pose them chosen once for all. Between the position of P and that of P′ there is a constant relation. What this relation is does not matter; enough that it be constant.

These two worlds will be indistinguishable one from the other; in other words, the first will be for its inhabitants what the second is for its. This will continue to be the case as long as the two worlds remain strangers to each other.

Suppose we live in a world A and have constructed our science and in particular our geometry. In the meantime the inhabitants of world B will have constructed a science, and as their world is the image of ours their geometry will also be the image of ours or, better, it will be the same as ours. But if some day a window is opened for us upon world B, how we shall pity them! "Poor things," we shall say, "they think they have made a geometry, but what they call so is only a grotesque image of our own; their straights are all twisted, their circles are humped, their spheres have capricious inequalities." And we shall never suspect that they say the same of us, and no one will ever know who is right.

We see in how broad a sense the relativity of space should be understood. Space is in reality amorphous and only the things which are in it give it form. What then should be thought of that direct intuition we should have of the straight or of distance? So little do we have any intuition of distance in itself that in the night, as we have said, a distance might become a thousand times greater without our being able to perceive it, if all other distances had undergone the same alteration. And in a night the world B might even be substituted for the world A without our having any way of knowing it, and then the straight lines of yesterday would have ceased to be straight and we should never be the wiser.

One part of space is not, by itself and in the absolute

sense of the word, equal to another part of space; because if it is so for us, it would not be so for the dwellers in the world B; and these have just as much right to reject our opinion as we have to condemn theirs.

I have elsewhere[2] shown what are the consequences of these facts from the view-point of non-Euclidean geometry and other analogous geometries; to that I do not care to return; and to-day I shall take a somewhat different point of view.

II.

If this intuition of distance, of direction, of the straight line—if this direct intuition of space, in a word—does not exist, whence comes our belief that we have it?

If this is only an illusion, why is this illusion so tenacious? It is proper to examine into this. We have said there is no direct intuition of size and we can arrive at only the relation of this magnitude to our instruments of measure. We should therefore not have been able to construct space if we had not had an instrument to measure it; and this instrument to which we relate everything, which we use instinctively, is our own body.

It is in relation to our body that we place exterior objects, and the only spatial relations of these objects that we can represent are their relations to our body. It is our body which serves us, so to speak, as system of axes of coordinates.

For example at one instant α, the presence of the object A is revealed to me by the sense of sight; at another instant β, the presence of another object B is revealed to me by another sense, that of hearing or of touch, for instance. I judge that this object B occupies the same place as the object A. What does this mean? First it does not signify that these two objects occupy, at two different

[2] In *Science et hypothèse* and *La valeur de la science*.—Tr.

moments, the same point of an absolute space, which even if it existed would escape our cognition, since between the instants α and β the solar system has moved and we cannot know its displacement. It means that these two objects occupy the same relative position with reference to our own body.

But even this, what does it mean? The impressions that have come to us from these objects have followed absolutely different paths, the optic nerve for the object A, the acoustic nerve for the object B. They have nothing in common from the quantitative point of view. The representations we are able to make of these two objects are absolutely heterogeneous, irreducible one to the other. Only I know that to reach the object A, I have merely to extend the right arm in a certain way. Even when I abstain from doing it, I represent to myself the muscular and other analogous sensations which would accompany this extension, and this representation is associated with that of the object A.

Now I likewise know I can reach the object B by extending my right arm in the same manner, an extension accompanied by the same train of muscular sensations. And when I say these two objects occupy the same place, I mean nothing more.

I also know I could have reached the object A by another appropriate motion of the left arm, and I represent to myself the muscular sensations which would have accompanied this movement; and by this same motion of the left arm accompanied by the same sensations, I likewise could have reached the object B.

And that is very important, since thus I can defend myself against dangers menacing me from the object A or the object B. With each of the blows that can hit us, nature has associated one or more parries which permit of our guarding ourselves. The same parry may respond

to several strokes; and so it is, for instance, that the same motion of the right arm would have allowed us to guard at the instant α against the object A and at the instant β against the object B. Just so the same stroke can be parried in several ways, and we have said, for instance, the object A could be reached indifferently either by a certain movement of the right arm or by a certain movement of the left arm.

All these parries have nothing in common except warding off the same blow, and this and nothing else is meant when we say they are movements terminating at the same point of space. Likewise, these objects, which we say occupy the same point of space, have nothing in common, except that the same parry guards against them.

Or, if you choose, imagine innumerable telegraph wires, some centripetal, others centrifugal. The centripetal wires warn us of accidents happening without; the centrifugal wires carry the reparation. Connections are so established that when a centripetal wire is traversed by a current this acts on a relay and so starts a current in one of the centrifugal wires, and things are so arranged that several centripetal wires may act on the same centrifugal wire if the same remedy suits several ills, and that a centripetal wire may agitate different centrifugal wires, either simultaneously or in lieu of one another when the same ill may be cured by several remedies.

This complex system of associations, this table of distribution, so to speak, comprises all our geometry, or, if you wish, all in our geometry that is instinctive. What we call our intuition of the straight line or of distance is the consciousness we have of these associations and of their imperious character. It is easy to understand whence comes this imperious character itself. An association will seem to us by so much the more indestructible as it is more ancient. But these associations are not for the most

part conquests of the individual, since their trace is seen in the new-born babe; they are conquests of the race. Natural selection had to bring about these conquests the more quickly, the more necessary they were.

On this account, those of which we speak must have been among the earliest in date, since without them the defence of the organism would have been impossible. From the time when the cellules were no longer merely juxtaposed, but were called upon to give mutual aid, it was needful that a mechanism be organized analogous to that we have described, so that this aid would not miss its way, but forestall the peril.

When a frog is decapitated, and a drop of acid is placed on a point of its skin, it seeks to wipe off the acid with the nearest foot, and if this foot be amputated, it sweeps it off with the foot of the opposite side. Here we have the double parry of which I have just spoken, allowing the combating of an ill by a second remedy, if the first fails. It is this multiplicity of parries, and the resulting coordination, which is space.

We see to what depths of the unconscious we must descend to find the first traces of these spatial associations, since only the inferior parts of the nervous system are involved. Why be astonished then at the resistance we oppose to every attempt to dissociate what so long has been associated? Now, it is just this resistance that we call the evidence for the geometric truths. This evidence is nothing but the repugnance we feel toward breaking with very old habits which have always proved good.

III.

The space so created is only a little space extending no farther than my arm can reach; the intervention of the memory is necessary to push back its limits. There are points which will remain out of my reach, whatever effort I make

to stretch forth my hand; if I were fastened to the ground like a hydropolyp, for instance, which can only extend its tentacles, all these points would be outside of space, since the sensations we could experience from the action of bodies there situated, would be associated with the idea of no movement allowing us to reach them, of no appropriate parry. These sensations would not seem to us to have any spatial character, and we should not seek to localize them.

But we are not fixed to the ground like some of the lower animals; we can, if the enemy be too far away, advance toward him first and extend a hand when we are sufficiently near. This is still a parry, but a parry at long range.

On the other hand, it is a complex parry, and into the representation we make of it enters the representation of the muscular sensations caused by the movements of the legs, that of the muscular sensations caused by the final movement of the arm, that of the sensations of the semicircular canals, etc. We must besides represent to ourselves, not a complex of simultaneous sensations, but a complex of successive sensations, following each other in a determinate order, and this is why I have just said that the intervention of memory was necessary.

Notice moreover that to reach the same point I may approach nearer the mark to be attained, so as to have to stretch my arm less. What more? It is not one, it is a thousand parries I can oppose to the same danger. All these parries are made of sensations which may have nothing in common and yet we regard them as defining the same point of space, since they may respond to the same danger and are all associated with the notion of this danger. The potentiality of warding off the same stroke makes the unity of these different parries, just as the possibility of being parried in the same way makes the unity of such

different kinds of strokes which may menace us from the same point of space. It is this double unity which makes the individuality of each point of space, and, in the notion of point, there is nothing else.

The space before considered, which might be called *restricted space,* was referred to coordinate axes attached to my body; these axes were fixed, since my body did not move and only my members changed their position.

What are the axes to which we naturally refer extended space, that is to say, the new space just defined? We define a point by the sequence of movements to be made to reach it, starting from a certain initial position of the body. The axes are therefore fixed to this initial position of the body.

But the position I call initial may be arbitrarily chosen among all the positions my body has successively occupied; if the more or less unconscious memory of these successive positions is necessary for the genesis of the notion of space, this memory may go back more or less remotely into the past. Thence results in the definition itself of space a certain indeterminateness, and it is precisely this indetermination which constitutes its relativity.

There is no absolute space; there is only space relative to a certain initial position of the body. For a conscious being fixed to the ground like some of the lower animals, and consequently knowing only restricted space, space would still be relative (since it would have reference to his body), but this being would not be conscious of this relativity, because the axes of reference for this restricted space would be unchanging. Doubtless the rock to which this being would be fettered would not be motionless, since it would be carried along in the movement of our planet; for us consequently these axes would change at each instant; but for him they would be changeless.

We have the faculty of referring our extended space

now to the position A of our body, considered as initial, again to the position B, which it had some moments afterward, and which we are free to regard in its turn as initial; we make therefore at each instant unconscious transformations of coordinates. This faculty would be lacking in our imaginary being, and from not having traveled, he would think space absolute. At every instant, his system of axes would be imposed upon him; this system would have to change greatly in reality, but for him it would be always the same, since it would be always the *only* system. Quite otherwise is it with us, who at each instant have many systems among which we may choose at will, on condition of going back by memory more or less far into the past.

This is not all. Restricted space would not be homogeneous; the different points of this space could not be regarded as equivalent, since some could be reached only at the cost of the greatest efforts, while others could be easily attained. On the contrary, our extended space seems to us homogeneous, and we say all points are equivalent.

What does this mean? If we start from a certain place A, we can, from this position, make certain movements M, characterized by a certain complex of muscular sensations. But, starting from another position B, we make movements M′ characterized by the same muscular sensations. Let *a*, then, be the situation of a certain point of the body, the end of the index finger of the right hand for example, in the initial position A, and *b* the situation of this same index when, starting from this position A, we have made the motions M. Afterwards, let *a′* be the situation of this index in the position B, and *b′* its situation when, starting from the position B, we have made the motions M′.

I am accustomed to say that the points of space *a* and *b* are related to each other just as are the points *a′* and *b′*, and this simply means that the two series of movements

M and M′ are accompanied by the same muscular sensations. And as I am conscious that, in passing from the position A to the position B, my body has remained capable of the same movements, I know there is a point of space related to the point *a′* just as any point *b* is to the point *a*, so that the two points *a* and *a′* are equivalent. This is what is called the homogeneity of space. And at the same time this is why space is relative, since its properties remain the same whether it be referred to the axes A or to the axes B, so that the relativity of space and its homogeneity are one sole and same thing.

Now if I wish to pass to the great space, which no longer serves only for me, but where I may lodge the universe, I get there by an act of imagination. I imagine how a giant would feel who could reach the planets in a few steps; or, if you choose, what I myself should feel in presence of a miniature world where these planets were replaced by little balls , while on one of these little balls moved a liliputian whom I should call myself. But this act of imagination would be impossible for me, had I not previously constructed my restricted space and my extended space for my own use.

IV.

Why have all these spaces three dimensions? Go back to the "table of distribution" of which we have spoken. We have on the one side the list of the different possible dangers; designate them by A1, A2, etc.; and on the other side, the list of the different remedies which I shall call in the same way B1, B2, etc. We have then connections between the contact studs or push buttons of the first list and those of the second, so that when, for instance, the announcer of danger A3 functions, it will put or may put in action the relay corresponding to the parry B4.

As I have spoken above of centripetal or centrifugal

wires, I fear lest some one see in all this, not a simple comparison, but a description of the nervous system. Such is not my thought for several reasons: first, I should not permit myself to put forth an opinion on the structure of the nervous system which I do not know, while those who have studied it speak only circumspectly; again, because, despite my incompetence, I well know this scheme would be too simplistic; and, finally, because on my list of parries, some would figure very complex, which might even, in the case of extended space, as we have seen above, consist of many steps followed by a movement of the arm. It is not a question then of physical connection between two real conductors, but of psychologic association between two series of sensations.

If A1 and A2 for instance are both associated with the parry B1, and if A1 is likewise associated with the parry B2, it will generally happen that A2 and B2 will also themselves be associated.

If this fundamental law were not generally true, there would exist only an immense confusion and there would be nothing resembling a conception of space or a geometry. How in fact have we defined a point of space? We have done it in two ways: it is on the one hand the aggregate of announcers A in connection with the same parry B; it is on the other hand the aggregate of parries B in connection with the same announcer A. If our law was not true, we should say A1 and A2 correspond to the same point since they are both in connection with B1; but we should likewise say they do not correspond to the same point, since A1 would be in connection with B2 and the same would not be true of A2. This would be a contradiction.

But, from another side, if the law were rigorously and always true, space would be very different from what it is. We should have categories strongly contrasted be-

tween which would be portioned out on the one hand the announcers A, on the other hand the parries B; these categories would be excessively numerous, but they would be entirely separated one from another. Space would be composed of points very numerous, but discrete; it would be *discontinuous*. There would be no reason for ranging these points in one order rather than another, nor consequently for attributing to space three dimensions.

But it is not so; permit me to resume for a moment the language of those who know geometry; this is quite proper since this is the language best understood by those I wish to make understand me.

When I desire to parry the stroke, I seek to reach the point from which the blow comes, but it suffices that I approach quite near. Then the parry B1 may answer for A1 and for A2, if the point which corresponds to B1 is sufficiently near both to that corresponding to A1 and to that corresponding to A2.

But it may happen that the point corresponding to another parry B2 may be sufficiently near the point corresponding to A1 and not sufficiently near the point corresponding to A2; so that the parry B2 may answer for A1 without answering for A2.

For one who is not acquainted with geometry, this translates itself simply by a derogation of the law stated above. And then things will happen thus: Two parries B1 and B2 will be associated with the same warning A1 and with a large number of warnings which we shall range in the same category as A1 and which we shall make correspond to the same point of space.

But we may find warnings A2 which will be associated with B2 without being associated with B1, and which in compensation will be associated with B3, which B3 was not associated with A1, and so forth, so that we may write the series

$B_1, A_1, B_2, A_2, B_3, A_3, B_4, A_4,$

where each term is associated with the following and the preceding, but not with the terms several places away. Needless to add that each of the terms of these series is not isolated but forms part of a very numerous category of other warnings or of other parries having the same connections, and which may be regarded as belonging to the same point of space.

The fundamental law, though admitting of exceptions, remains therefore almost always true. Only, in consequence of these exceptions, these categories, in place of being entirely separated, encroach partially one upon another and mutually penetrate in a certain measure, so that space becomes continuous.

On the other hand, the order in which these categories are to be ranged is no longer arbitrary, and if we refer to the preceding series we see it is necessary to put B_2 between A_1 and A_2 and consequently between B_1 and B_3, and that we could not for instance put it between B_3 and B_4.

There is therefore an order, corresponding to the points of space, in which we naturally arrange our categories, and experience teaches us that this order presents itself under the form of a table of triple entry, and this is why space has three dimensions.

V.

So the characteristic property of space, that of having three dimensions, is only a property of our table of distribution, an internal property of the human intelligence, so to speak. It would suffice to destroy certain of these connections, that is to say of these associations of ideas, to give a different table of distribution, and that might be enough for space to acquire a fourth dimension.

Some persons will be astonished at such a result. The

external world, they will think, should count for something. If the number of dimensions comes from the way we are made, there might be thinking beings living in our world, but who might be made differently from us and who would believe space has more or less than three dimensions. Has not M. de Cyon said that the Japanese mice, having only two pair of semi-circular canals, believe that space is two-dimensional? And then would not this thinking being, if he is capable of constructing a physics, make a physics of two or of four dimensions, and which in a sense would still be the same as ours, since it would be the description of the same world in another language?

It seems in fact that it would be possible to translate our physics into the language of geometry of four dimensions; to attempt this translation would be to take great pains for little profit, and I shall confine myself to citing the mechanics of Hertz where we have something analogous. However it seems that the translation would always be less simple than the text, and that it would always have the air of a translation, that the language of three dimensions seems the better fitted to the description of our world, although this description can be rigorously made in another idiom.

Besides, our table of distribution was not made at random. There is connection between the warning A1 and the parry B1, this is an internal property of our intelligence; but why this connection? It is because the parry B1 affords means effectively to guard against the danger A1; this is a fact exterior to us, it is a property of the exterior world. Our table of distribution is therefore only the translation of an aggregate of exterior facts; if it has three dimensions, this is because it has adapted itself to a world having certain properties; and the chief of these properties is that there exist natural solids whose displacements follow sensibly the laws we call laws of motion of

rigid solids. If therefore the language of three dimensions is that which permits us most easily to describe our world, we should not be astonished; this language is copied from our table of distribution, and it is in order to be able to live in this world that this table has been established.

I have said we could conceive, living in our world, thinking beings whose table of distribution would be four-dimensional and who consequently would think in hyperspace. It is not certain however that such beings, admitting they were born there, could live there and defend themselves against the thousand dangers by which they would be assailed.

VI.

A few remarks to end with. There is a striking contrast between the roughness of this primitive geometry, reducible to what I call a table of distribution, and the infinite precision of the geometers' geometry. And yet the latter is born of the former, but not of that alone; it must be made fruitful by the faculty we have of constructing mathematical concepts, such as that of group, for instance. It was needful to seek among the pure concepts that which best adapts itself to this rough space whose genesis I have sought to explain and which is common to us and the higher animals.

The evidence for certain geometric postulates, we have said, is only our repugnance to renouncing very old habits. But these postulates are infinitely precise, while these habits have something about them essentially pliable. When we wish to think, we need postulates that are infinitely precise, since this is the only way to avoid contradiction; but among all the possible systems of postulates there are some we dislike to choose because they are not sufficiently in accord with our habits; however pliable, however elastic they may be, they have a limit of elasticity.

We see that if geometry is not an experimental science, it is a science born *à propos* of experience; that we have created the space it studies, but adapt it to the world wherein we live. We have selected the most convenient space, but experience has guided our choice. As this choice has been unconscious, we think it has been imposed upon us; some say experience imposes it, others that we are born with our space ready made. We see from the preceding considerations, what in these two opinions is the part of truth, what of error.

In this progressive education whose outcome has been the construction of space, it is very difficult to determine what is the part of the individual, what the part of the race. How far could one of us, transported from birth to an entirely different world, where were dominant, for instance, bodies moving in conformity to the laws of motion of non-Euclidean solids, renounce his ancestral space to build a space completely new?

The race seems indeed to play a preponderant part; yet if to it we owe rough space, the pliable space I have spoken of, the space of the higher animals, is it not to the unconscious experience of the individual we owe the infinitely precise space of the geometer?

This is a question not easy to solve. Yet we cite a fact showing that the space our ancestors have bequeathed us still retains a certain plasticity. Some hunters learn to shoot fish under water, though the image of the fish be displaced by refraction. Besides they do it instinctively. They therefore have learned to modify their old instinct of direction, or, if you choose, to substitute for the association A1, B1 another association A1, B2, because experience showed them the first would not work.

HENRI POINCARÉ.

MARK TWAIN'S PHILOSOPHY.[1]

Mark Twain wrote a book entitled *What is Man?* but he kept the fact a secret for it was not published until after his death. It was printed in New York at the De Vinne Press in an edition of two hundred and fifty copies, during July, 1906. Its copyright dates from the same year and it is prefaced under date of February, 1905, as follows:

The studies for these papers were begun twenty-five or twenty-seven years ago. The papers were written seven years ago. I have examined them once or twice per year since and found them satisfactory. I have just examined them again, and am still satisfied that they speak the truth.

Every thought in them has been thought (and accepted as unassailable truth) by millions upon millions of men—and concealed, kept private. Why did they not speak out? Because they dreaded (and could not bear) the disapproval of the people around them. Why have I not published? The same reason has restrained me, I think. I can find no other.

The book is published under Mark Twain's own name, Samuel Langhorne Clemens. This is significant, for here Mark Twain does not speak to us, but Mr. Clemens; not a humorist, but the man himself who has written under the pseudonym "Mark Twain." This book is not for our amusement, but for our instruction. Here our author does not mean to make jokes, he is serious. He is too serious

[1] Because the quotations from Mr. Clemens are the most important feature of this article, they are printed in large type while our own considerations and objections appear in more modest size. Thus indicating difference of authorship by difference in type we can dispense with the use of quotation marks in the main selections from Mark Twain.

to make any attempt at giving his treatment charm or pleasing form. How easy would it have been to treat the subject in the happy style of his unexcelled humor! He absolutely abstains from all jollity for to him the truth which he preaches is sad, very sad; he claims that man is a machine—nothing more.

The treatment of this subject is keen in argument but dull, in parts it is extremely dull, and dry in style. It is cast into the form of a monotonous conversation between an old man representing himself, Mr. Clemens, in his matured years, and a youth who is unwilling to recognize the truth. He says:

The Old Man and the Young Man had been conversing. The Old Man had asserted that the human being is merely a machine, and nothing more. The Young Man objected, and asked him to go into particulars and furnish his reason for his position.

A machine has no merit. An inferior machine—say one manufactured of stone—cannot help being inferior and a superior machine does not deserve credit for being better. The conversation continues:

Old Man. What could the stone engine do?

Young Man. Drive a sewing-machine, possibly—nothing more, perhaps.

O. M. Men would admire the other engine and rapturously praise it?

Y. M. Yes.

O. M. But not the stone one?

Y. M. No.

O. M. The merits of the metal machine would be far above those of the stone one.

Y. M. Of course.

O. M. Personal merits?

Y. M. Personal merits? How do you mean?

O. M. It would be personally entitled to the credit of its own performance?

Y. M. The engine? Certainly not.

O. M. Why not?

Y. M. Because its performance is not personal. It is a result of the law of its construction. It is not a merit that it does things which it is set to do—it can't help doing them.

O. M. And it is not a personal demerit in the stone machine that it does so little?

Y. M. Certainly not. It does no more and no less than the law of its make permits and compels it to do. There is nothing personal about it; it cannot choose. In this process of "working up to the matter" is it your idea to work up to the proposition that man and a machine are about the same thing, and that there is no personal merit in the performance of either?

O. M. Yes—but do not be offended; I am meaning no offense. What makes the grand difference between the stone engine and the steel one? Shall we call it training, education? Shall we call the stone engine a savage and the steel one a civilized man? The original rock contained the stuff of which the steel one was built—but along with it a lot of sulphur and stone and other obstructing inborn heredities, brought down from the old geologic ages —prejudices, let us call them. Prejudices which nothing within the rock itself had either power to remove or any desire to remove. Will you take note of that phrase?

Y. M. Yes. I have written it down: "Prejudices which nothing within the rock itself had either power to remove or any desire to remove." Go on.

O. M. Prejudices which must be removed by outside influences or not at all. Put that down.

Y. M. Very well: "Must be removed by outside influences or not at all." Go on.

O. M. The iron's prejudice against ridding itself of the cumbering rock. To make it more exact, the iron's absolute indifference as to whether the rock be removed or not. Then comes the outside influence and grinds the rock to

powder and sets the ore free. The iron in the ore is still captive. An outside influence smelts it free of the clogging ore. The iron is emancipated iron, now, but indifferent to further progress. An outside influence beguiles it into the Bessemer furnace and refines it into steel of the first quality. It is educated now—its training is complete. And it has reached its limit. By no possible process can it be educated into gold. Will you set that down?

Y. M. Yes. "Everything has its limit—iron ore cannot be educated into gold."

O. M. There are gold men, and tin men, and copper men, and leaden men, and steel men, and so on—and each has the limitations of his nature, his heredities, his training and his environment. You can build engines out of each of these metals, and they will all perform, but you must not require the weak ones to do equal work with the strong ones. In each case, to get the best results, you must free the metal from its obstructing prejudicial ores by education—smelting, refining, and so forth.

Y. M. You have arrived at man, now?

O. M. Yes. Man the machine—man the impersonal engine. Whatsover a man is, is due to his make, and to the influences brought to bear upon it by his heredities, his habitat, his associations. He is moved, directed, *commanded,* by exterior influences — solely. He originates nothing, not even a thought.

Y. M. Oh, come! Where did I get my opinion that this which you are talking is all foolishness?

O. M. It is a quite natural opinion—indeed an inevitable opinion—but you did not create the materials out of which it is formed. They are odds and ends of thoughts, impressions, feelings, gathered unconsciously from a thousand books, a thousand conversations, and from streams of thought and feeling which have flowed down into your heart and brain out of the hearts and brains of centuries

of ancestors. Personally you did not create even the smallest microscopic fragment of the materials out of which your opinion is made; and personally you cannot claim even the slender merit of putting the borrowed materials together. That was done automatically—by your mental machinery, in strict accordance with the law of that machinery's construction. And you not only did not make that machinery yourself, but you have not even any command over it.

Y. M. This is too much. You think I could have formed no opinion but that one?

O. M. Spontaneously? No. And you did not form that one; your machinery did it for you—automatically and instantly, without reflection of the need of it.

Mark Twain is a good reasoner, but like so many professional philosophers he falls into the trap of his own nomenclature. He personifies abstract ideas. His terms such as "mind" and the "ego," become independent beings, and he has much to say of the task-master, of the stern judge whose approval every one seeks. But are not our mind and the stern master whose slaves we are, parts of ourselves? This stern master is the ultimate court of appeal which has originated in the course of the development of our humanity with unavoidable necessity; he is the climax of our moral evolution. Every man has his own master who is his better self, representing self-control, and the height thus attained is different in different persons. What the master decides is our own decision.

We are told that our stern master is a terrible tyrant; that if we do a good deed we do it because he compels us to do it; and if we are drunkards or thieves or murderers, we are such and act accordingly at his behest. We are not free, we are his slaves.

Let us restate the facts not in the mythological description of Mark Twain but as they really are: Man's mind is a complex multitude of ideas more or less systematically arranged. There are sensations and different centers of various sensation, there are motory centers, there is a language center, there is a special supreme ruler of the whole empire. He calls himself in common language "I," and this "I" (in philosophical language called *ego*) is practically what Mark Twain calls our master.

Now let us bear in mind that man's soul is a very complicated organism and consists of many different motor-ideas which press into action. They are relatively independent and sometimes irrepressible. As they are by no means agreed we would sometimes like to do several things at once which however is impossible. We can do one thing only at the time, and these different motor ideas must come to an agreement. Frequently there originates a quarrel among the motor ideas and one—of course the strongest one—takes the lead and compels the others to keep quiet, at least at the time. The quarrel, commonly called deliberation, ended, we say, "*I* will do this." This "I" is the center of our mentality, it is what Mark Twain calls our master, but closely considered this terrible tyrant is only another name for the representative of our self.

Mark Twain has not investigated how this master of ours has originated, and we will here try to explain the character of this important piece of machinery in a few lines. The ego of man is ultimately nothing but a center of thought. It is the mere word "I" and this word represents the entire personality. It is like the apex of a pyramid. Every one calls himself "I," but every one is different, and this little word means all the motor ideas, all the thoughts, the sentiments, the mental and bodily faculties, the appetites, ideas, conceptions, aspirations, convictions, and ideals of the personality for which it stands.

Among the multitudes of our tendencies there is one group predominant. It is built up of structures forged by repeated experiences and fortified by education. It has been condensed out of innumerable observations and reflections, proclaiming the result in the shape of principles. This is what is commonly called conscience. Mark Twain does not distinguish between the "I" and the conscience, but we would say that they are by no means the same. If the conscience takes possession of the "I" and makes the "I" act according to its dictates, we may very well say that we do an act for duty's sake, but no human person can do it unless the "I" adopts the advice of its conscience, and it is natural that we appreciate actions done in this way. A man-machine in which the conscience has this power is deemed superior to one in which the behests of the stern tyrant are set aside.

Besides the conscience there are other tendencies which have a strong hold on the "I." Among them we will mention the hankering after pleasure, and the nature of our pleasures depends very much upon the constitution of a personality down to its deepest and

most elementary roots in the lower structures of the sensual centers. There are men of all kinds of temper and inclination, developed under different conditions of life. There is the drunkard, there is the combative man who looks for a quarrel, there is the lover of gain who would enjoy taking advantage of his neighbor in business, there is the miser, and besides all the vicious kinds of men there are those of indifferent and also of noble tendencies.

The slightest disposition in our minds may be characterized as a piece of machinery which will assert its influence upon the whole in one way or another. The whole composition of the soul must be granted to be analogous to a machine, and we may even call its activity mechanical or machine-like. Every deliberation in the minds of man is a mechanical process, and we may very well speak of the dynamics of the mind. Educators and reformers ought to know this truth, and when it comes to practical work they act as if for education nothing was needed more than the insertion of machinery which will work for good.

The tendency to stimulate the human mind by wrong motives for accomplishing good ends is quite common, and it is this mainly which Mark Twain criticizes in our religious teachings. Mark Twain is quite right in saying that a pious Christian does not do an act of self-sacrifice for the sake of God or of Christ, or whatever his idea may be of the all-compelling divine authority which he obeys, but he follows his own master in him, and he must please him first. But what he really means to say, if we replace his mythological terminology by straight facts, is this, that before any person would live up to a certain ideal this ideal must be adopted as his own; it must gain his approval. A man must be able to say: "I will do this work of self-sacrifice," and Mark Twain's notion in attributing to the word "I" the rôle of a master who governs us had better be expressed in this way, that nothing, neither our vicious hankering after detrimental pleasure nor our nobler tendencies for doing good to our fellowmen or bringing any self-sacrifice, can be done by us until we ourselves decide upon the course of action we want to pursue. This means that every one in coming to a decision must be able to say: "I do this because this is my inmost desire," "this pleases me," "this I do because I adopt this motor idea as my own." This cerebral structure which says "I" in us, this apex of our soul, the center of our personality, pronounces a decision, the result of a deliberation, and is an expression of our self. Accordingly this is

not an act of slavish subjection, but it characterizes the nature of our inner being.

The ego of man is, as it were, surrounded by its ministers who represent the different departments of his being. There are his animal instincts, there are his preferences. Every man has his own special tendencies and ideals; there are some who are anxious to collect treasures of art, others to accomplish certain deeds, others to acquire accomplishments, others to make a fortune, and there is no limit to the varieties of tendencies in different persons. The art of influencing one's fellows consists exactly in knowing the idiosyncrasies wherewith they can be baited. A practical psychologist can play on these preferences as an organist may play on the organ. An instance of how different characters have to be handled may be found in the story of Reynard the Fox, who dupes the cat by a prospect of catching mice and the bear by his fondness for honey.

Mark Twain's philosophy is true as to facts but his attitude is wrong, and the source of his error lies in the mistaken mythology in which he dresses his psychological nomenclature. His dialogue continues:

O. M. I am sorry, but you see, yourself, that your mind is merely a machine, nothing more. You have no command over it, it has no command over itself—it is worked solely from the outside. That is the law of its make; it is the law of all machines.

Y. M. Can't I ever change one of these automatic opinions?

O. M. No. You can't yourself, but exterior influences can do it.

Y. M. And exterior ones only?

O. M. Yes—exterior ones only.

Y. M. That position is untenable—I may say ludicrously untenable.

O. M. What makes you think so?

Y. M. I don't merely think it, I know it. Suppose I resolve to enter upon a course of thought, and study, and reading, with the deliberate purpose of changing that opin-

ion; and suppose I succeed. That is not the work of an exterior impulse, the whole of it is mine *in persona*; for I originated the project.

O. M. Not a shred of it. It grew out of this talk with me. But for that it would never have occurred to you. No man ever originates anything. All his thoughts, all his impulses, come from the outside.

Y. M. It's an exasperating subject. The first man had original thoughts, anyway; there was nobody to draw from.

O. M. It is a mistake. Adam's thoughts came to him from the outside. You have a fear of death. You did not invent that—you got it from outside, from talk and teaching. Adam had no fear of death—none in the world.

Y. M. Yes he had.

O. M. When he was created?

Y. M. No.

O. M. When, then?

Y. M. When he was threatened with it.

O. M. Then it came from the outside. Adam is quite big enough; let us not try to make a god of him. None but gods have ever had a thought which did not come from the outside. Adam probably had a good head, but it was of no sort of use to him until it was filled up from the outside. He was not able to invent the triflingest little thing with it. He had not a shadow of a notion of the difference between good and evil—he had got the idea from the outside.

To this rule that man is a machine and that the grist which the will of his mind works out comes from the outside, even a genius is no exception.

O. M. Shakespeare created nothing. He correctly observed, and he marvelously painted. He exactly portrayed people whom God had created; but he created none himself. Let us spare him the slander of charging him with trying. Shakespeare could not create. He was a machine, and machines do not create.

Mark Twain claims that there is no personal merit. We are what we are because God, or whatever you will call outside influences, made us so.

O. M. Personal merit? No. A brave man does not create his bravery. He is entitled to no personal credit for possessing it. It is born to him. A baby born with a billion dollars—where is the personal merit in that? A baby born with nothing—where is the personal demerit in that? The one is fawned upon, admired, worshiped, by sycophants; the other is neglected and despised—where is the sense in it?

Y. M. Sometimes a timid man sets himself the task of conquering his cowardice and becoming brave—and succeeds. What do you say to that?

O. M. That it shows the value of training in right directions over training in wrong ones. Estimably valuable is training, influence, education, in right directions—training one's self-approbation to elevate its ideals. . . . In the world's view he is a worthier man than he was before, but he didn't achieve the change—the merit of it is not his.

The Old Man explains that "David was brave and fought Goliath. A coward would not have done it. David could not help being brave." This shocks the Young Man who exclaims, "Hang it, where is the sense in his becoming brave if he is to get no credit for it?" and the Old Man answers, "The sole impulse that ever moves a person to do a thing" is "the necessity of contenting his own spirit and winning its approval." This subject is discussed in a special chapter, and this idea forms the key to Mark Twain's psychology. He says:

Yes, this is the law, keep it in your mind. From his cradle to his grave a man never does a single thing which has any *first and foremost* object but one, to secure peace of mind, spiritual comfort, for *himself*.

As an instance he cites the duel of Alexander Hamilton. He says:

O. M. Alexander Hamilton was a conspicuously high-principled man. He regarded duelling as wrong, and as opposed to the teachings of religion—but in deference to public opinion he fought a duel. He deeply loved his family, but to buy public approval he treacherously deserted them and threw his life away, ungenerously leaving them to life-long sorrow in order that he might stand well with a foolish world. In the then condition of the public standards of honor he could not have been comfortable with the stigma upon him of having refused to fight. The teachings of religion, his devotion to his family, his kindness of heart, his high principles, all went for nothing when they stood in the way of his spiritual comfort. A man will do anything, no matter what it is, to secure his spiritual comfort; and he can neither be forced nor persuaded to any act which has not that goal for its object. Hamilton's act was compelled by the inborn necessity of contenting his own spirit; in this it was like all the other acts of life, and like all the acts of all men's lives. Do you see where the kernel of the matter lies? A man cannot be comfortable without his own approval. He will secure the largest share possible of that, at all costs, all sacrifices.

Y. M. A minute ago you said Hamilton fought that duel to get public approval.

O. M. I did. By refusing to fight the duel he would have secured his family's approval and a large share of his own; but the public approval was more valuable in his eyes than all other approvals put together—in the earth or above it; to secure that would furnish him the most comfort of mind, the most self-approval; so he sacrificed all other values to get it.

Y. M. Some noble souls have refused to fight duels, and have manfully braved the public contempt.

O. M. They acted according to their make. They val-

ued their principles and the approval of their families above the public approval. They took the thing they valued most and let the rest go. They took what would give them the largest share of personal contentment and approval—a man always does. Public opinion cannot force that kind of men to go to the wars. When they go it is for other reasons. Other spirit-contenting reasons.

The motives which are generally given are, according to the Old Man, wrong names. The Young Man asks for the meaning of love, hate, charity, revenge, humanity, magnanimity, forgiveness, but he is put down by the Old Man who says:

Different results of the one Master Impulse: the necessity of securing one's self-approval. They wear diverse clothes and are subject to diverse moods, but in whatsoever ways they masquerade they are the same person all the time. To change the figure, the compulsion that moves a man—and there is but one—is the necessity of securing the contentment of his own spirit. When it stops, the man is dead.

Y. M. That is foolishness. Love—

O. M. Why, love is that impulse, that law, in its most uncompromising form. It will squander life and everything else on its object. Not primarily for the object's sake, but for its own. When its object is happy it is happy—and that is what it is unconsciously after.

Y. M. You do not even except the lofty and gracious passion of mother-love?

O. M. No, it is the absolute slave of that law. The mother will go naked to clothe her child; she will starve that it may have food; suffer torture to save it from pain; die that it may live. She takes a living pleasure in making these sacrifices. She does it for that reward—that self-approval, that contentment, that peace, that comfort. She would do it for your child *if she could get the same pay.*

Y. M. This is an infernal philosophy of yours.

O. M. It isn't a philosophy, it is a fact.

No other motives count. That impulse in us is our master and there is no virtue, no self-sacrifice. The Old Man says:

Men pretend to self-sacrifices, but this is a thing which in the ordinary value of the phrase, does not exist and has not existed. A man often honestly thinks he is sacrificing himself merely and solely for some one else, but he is deceived; his bottom impulse is to content a requirement of his nature and training, and thus acquire peace for his soul.

Y. M. Apparently, then, all men, both good and bad ones, devote their lives to contenting their consciences?

O. M. Yes. That is a good enough name for it: Conscience—that independent Sovereign, that insolent absolute Monarch inside of a man who is man's Master. There are all kinds of consciences, because there are all kinds of men. You satisfy an assassin's conscience in one way, a philanthropist's in another, a miser's in another, a burglar's in still another. As a guide or incentive to any authoritatively prescribed line of morals or conduct, (leaving training out of the account,) a man's conscience is totally valueless. I knew a kind-hearted Kentuckian whose self-approval was lacking—whose conscience was troubling him, to phrase it with exactness—because he had neglected to kill a certain man—a man whom he had never seen. The stranger had killed this man's friend in a fight, this man's Kentucky training made it a duty to kill the stranger for it. He neglected his duty—kept dodging it, shirking it, putting it off, and his unrelenting conscience kept persecuting him for his conduct. At last, to get ease of mind, comfort, self-approval, he hunted up the stranger and took his life. It was an immense act of self-sacrifice (as per the usual definition) for he did not want to do it, and he never would have done it if he could have bought a con-

tented spirit and an unworried mind at smaller cost. But we are so made that we will pay anything for that contentment—even another man's life.

Our master is our conscience, but the Old Man concedes at least that conscience can be trained to shun evil and prefer good, but under all circumstances the voice of the conscience is admitted "for spirit-contenting reasons only." Concerning conscience Mark Twain inserts a little story. He says:

O. M. I will tell you a little story:

Once upon a time an Infidel was guest in the house of a Christian widow whose little boy was ill and near to death. The Infidel often watched by the bedside and entertained the boy with talk, and he used these opportunities to satisfy a strong longing of his nature—that desire which is in us all to better other people's condition by having them think as we think. He was successful. But the dying boy, in his last moments, reproached him and said:

"I believed, and was happy in it; you have taken my belief away, and my comfort. Now I have nothing left, and I die miserable; for the things which you have told me do not take the place of that which I have lost."

And the mother also reproached the Infidel, and said:

"My child is forever lost, and my heart is broken. How could you do this cruel thing? We have done you no harm but only kindness; we made our house your home, you were welcome to all we had, and this is our reward."

The heart of the Infidel was filled with remorse for what he had done, and he said:

"It was wrong—I see it now; but I was only trying to do him good. In my view he was in error; it seemed my duty to teach him the truth."

Then the mother said:

"I had taught him, all his little life, what I believed to be the truth, and in his believing faith both of us were happy. Now he is dead—and lost; and I am miserable

Our faith came down to us through centuries of believing ancestors; what right had you, or any one, to disturb it? Where was your honor, where was your shame?

Y. M. He was a miscreant, and deserved death!

O. M. He thought so himself, and said so.

Y. M. Ah—you see, his conscience was awakened!

O. M. Yes—his self-disapproval was. It pained him to see the mother suffer. He was sorry he had done a thing which brought him pain. It did not occur to him to think of the mother when he was mis-teaching the boy, for he was absorbed in providing pleasure for himself, then. Providing it by satisfying what he believed to be a call of duty.

Y. M. Call it what you please, it is a case of awakened conscience. That awakened conscience could never get itself into that species of trouble again. A cure like that is a permanent cure.

O. M. Pardon—I had not finished the story. We are creatures of outside influences — we originate nothing within. Whenever we take a new line of thought and drift into a new line of belief and action, the impulse is always suggested from the outside. Remorse so preyed upon the Infidel that it dissolved his harshness toward the boy's religion and made him come to regard it with tolerance, next with kindness, for the boy's sake and the mother's. Finally he found himself examining it. From that moment his progress in his new trend was steady and rapid. He became a believing Christian. And now his remorse for having robbed the dying boy of his faith and his salvation was bitterer than ever. It gave him no rest, no peace. He must have rest and peace—it is the law of our nature. There seemed but one way to get it; he must devote himself to saving imperiled souls. He became a missionary. He landed in a pagan country ill and helpless. A native widow took him into her humble home and nursed

him back to convalescence. Then her young boy was taken hopelessly ill, and the grateful missionary helped her tend him. Here was his first opportunity to repair a part of the wrong done to the other boy by doing a precious service for this one by undermining his foolish faith in his false gods. He was successful. But the dying boy in his last moments reproached him and said:

"I believed, and was happy in it; you have taken my belief away, and my comfort. Now I have nothing left and I die miserable; for the things which you have told me do not take the place of that which I have lost."

And the mother, also, reproached the missionary, and said:

"My child is forever lost, and my heart is broken. How could you do this cruel thing? We had done you no harm, but only kindness; we made our house your home, you were welcome to all we had, and this is our reward."

The heart of the missionary was filled with remorse for what he had done, and he said:

"It was wrong—I see it now; but I was trying to do him good. In my view he was in error; it seemed my duty to teach him the truth."

Then the mother said:

"I had taught him, all his little life, what I believed to be the truth, and in his believing faith both of us were happy. Now he is dead—and lost; and I am miserable. Our faith came down to us through centuries of believing ancestors; what right had you, or any one, to disturb it? Where was your honor, where was your shame?"

The missionary's anguish of remorse and sense of treachery were as bitter and persecuting and unappeasable, now, as they had been in the former case. The story is finished. What is your comment?

Y. M. The man's conscience was a fool! It was morbid. It didn't know right from wrong.

O. M. I am not sorry to hear you say that. If you grant that one man's conscience doesn't know right from wrong, it is an admission that there are others like it. This single admission pulls down the whole doctrine of infallibility in consciences. Meantime there is one thing which I ask you to notice.

Y. M. What is that?

O. M. That in both cases the man's act gave him no spiritual discomfort, and that he was quite satisfied with it and got pleasure out of it. But afterward when it resulted in pain to him he was sorry. Sorry it had inflicted pain upon the others, but for no reason under the sun except that their pain gave *him* pain. Our consciences take no notice of pain inflicted upon others until it reaches a point where it gives pain to us. In all cases without exception we are absolutely indifferent to another person's pain until his sufferings make us uncomfortable. Many an infidel would not have been troubled by that Christian mother's distress. Don't you believe that?

Y. M. Yes. You might almost say it of the average infidel, I think.

O. M. And many a missionary, sternly fortified by his sense of duty, would not have been troubled by the pagan mother's distress—Jesuit missionaries in Canada in the early French times, for instance; see episodes quoted by Parkman.....

We have smuggled a word into the dictionary which ought not to be there at all—self-sacrifice. It describes a thing which does not exist. But worst of all, we ignore and never mention the sole impulse which dictates and compels a man's every act: the imperious necessity of securing his own approval, in every emergency, and at all costs. To it we owe all that we are.

This master in us is the best a man has and to him we owe our moral progress. This doctrine Mark Twain calls the "gospel of

self-approval." He illustrates it by summing up the contents of a novel in which a pious man abandons his lucrative lumber business and devotes himself to missionary work. He neglect all his duties in life, makes all those dependent on him miserable, and the apparent motive is not to serve the cause of Christ, but his vanity in being praised and flattered by a circle of pious Christians. When he fails to get his pay he is disappointed. The conclusion is that there is no self-sacrifice for others in the common meaning of the phrase, for "men make daily sacrifices for others, but it is for their own sake first." The same is true of duty:

O. M. No man performs a duty for mere duty's sake; the act must content his spirit first. He must feel better for doing the duty than he would for shirking it. Otherwise he will not do it.

Y. M. Take the case of the Berkeley Castle.

O. M. It was a noble duty, greatly performed. Take it to pieces and examine it, if you like.

Y. M. A British troop-ship crowded with soldiers and their wives and children. She struck a rock and began to sink. There was room in the boats for the women and children only. The colonel lined up his regiment on the deck and said, "It is our duty to die, that they may be saved." There was no murmur, no protest. The boats carried away the women and children. When the death-moment was come, the colonel and his officers took their several posts, the men stood at shoulder-arms, and so, as on dress-parade, with their flag flying and the drums beating, they went down, a sacrifice to duty for duty's sake. Can you view it as other than that?

O. M. It was something as fine as that, as exalted as that. Could you have remained in those ranks and gone down to your death in that unflinching way?

Y. M. Could I? No, I could not.

O. M. Think. Imagine yourself there, with that watery doom creeping higher and higher around you.

Y. M. I can imagine it. I feel all the horror of it. I

could not have endured it, I could not have remained in my place. I know it.

O. M. Why?

Y. M. There is no why about it: I know myself, and I know I couldn't do it.

O. M. But it would be your duty to do it.

Y. M. Yes, I know—but I couldn't.

O. M. It was more than a thousand men, yet not one of them flinched. Some of them must have been born with your temperament; if they could do that great duty for duty's sake, why not you? Don't you know that you could go out and gather together a thousand clerks and mechanics and put them on that deck and ask them to die for duty's sake, and not two dozen of them would stay in the ranks to the end?

Y. M. Yes, I know that.

O. M. But you train them, and put them through a campaign or two; then they would be soldiers; soldiers, with a soldier's pride, a soldier's self-respect, a soldier's ideals. They would have to content a soldier's spirit then, not a clerk's, not a mechanic's. They could not content that spirit by shirking a soldier's duty, could they?

Y. M. I suppose not.

O. M. Then they would do the duty not for the duty's sake, but for their own sake—primarily. The duty was just the same, and just as imperative, when they were clerks, mechanics, raw recruits, but they wouldn't perform it for that. As clerks and mechanics they had other ideals, another spirit to satisfy, and they satisfied it. They had to; it is the law. Training is potent. Training toward higher and higher, and ever higher ideals is worth any man's thought and labor and diligence.

The two important things are training and the inherited disposition of our character.

It is true there are seekers after truth, but Mark Twain con-

tends that seeking after truth is only temporary. No one will permanently seek after truth. The Old Man says:

We are always hearing of people who are around seeking after truth. I have never seen a (permanent) specimen. I think he has never lived. But I have seen several entirely sincere people who thought they were (permanent) seekers after truth. They sought diligently, persistently, carefully, cautiously, profoundly, with perfect honesty and nicely adjusted judgment—until they believed that without doubt or question they had found the truth. That was the end of the search. The man spent the rest of his life hunting up shingles wherewith to protect his truth from the weather. If he was seeking after political truth he found it in one or another of the hundred political gospels which govern men in the earth; if he was seeking after the only true religion he found it in one or another of the three thousand that are on the market. In any case, when he found the truth he sought no further; but from that day forth, with his soldering iron in one hand and his bludgeon in the other he tinkered its leaks and reasoned with objectors. There have been innumerable temporary seekers after truth—have you ever heard of a permanent one? In the very nature of man such a person is impossible.

This statement is repeated near the end of the discussion where Mark Twain confesses that he has ceased to be a seeker after truth, near the end of the story where he says:

I told you that there are none but temporary truth-seekers; that a permanent one is a human impossibility; that as soon as the seeker finds what he is thoroughly convinced is the truth, he seeks no further, but gives the rest of his days to hunting junk to patch it and caulk it and prop it with, and make it weather-proof and keep it from caving in on him. Hence the Presbyterian remains a Presbyterian, the Spiritualist a Spiritualist, the Democrat a

Democrat, the Republican a Republican, the Monarchist a Monarchist; and if a humble, earnest and sincere seeker after truth should find it in the proposition that the moon is made of green cheese, nothing could ever budge him from that position; for he is nothing but an automatic machine, and must obey the laws of his construction. And so having found the truth, perceiving that beyond question man has but one moving impulse—the contenting of his own spirit—and is merely a machine and entitled to no personal merit for any thing he does, it is not humanly possible for me to seek further. The rest of my days will be spent in patching and painting and puttying and caulking my priceless possession and in looking the other way when an imploring argument or a damaging fact approaches.

Concerning training we listen to the following conversation:

Y. M. Now then, I will ask you where there is any sense in training people to lead virtuous lives. What is gained by it?

O. M. The man himself gets large advantages out of it, and that is the main thing—to him. He is not a peril to his neighbors, he is not a damage to them—and so they get an advantage out of his virtues. That is the main thing to them. It can make this life comparatively comfortable to the parties concerned; the neglect of this training can make this life a constant peril and distress to the parties concerned.

Y. M. You have said that training is everything; that training is the man himself, for it makes him what he is.

O. M. I said training and another thing. . . . That other thing is temperament—that is, the disposition you were born with. You can't eradicate your disposition nor any rag of it—you can only put a pressure on it and keep it down and quiet. You have a warm temper?

Y. M. Yes.

O. M. You will never get rid of it; but by watching it you can keep it down nearly all the time. Its presence is your limit. Your reform will never quite reach perfection, for your temper will beat you now and then, but you will come near enough. You have made valuable progress and can make more. There is use in training. Immense use. . . . . Diligently train your ideals upward and still upward toward the summit where you will find your chiefest pleasure in conduct which, while contenting you, will be sure to confer benefits upon your neighbor and the community.

Y. M. Is that a new gospel?

O. M. No.

Y. M. It has been taught before?

O. M. For ten thousand years.

Y. M. By whom?

O. M. All the great religions—all the great gospels.

Y. M. Then there is nothing new about it?

O. M. Oh, yes, there is. It is candidly stated, this time. That has not been done before.

Y. M. How do you mean?

O. M. Haven't I put you *first,* and your neighbor and the community afterward?

Y. M. Well, yes, that is a difference, it is true.

O. M. The difference between straight speaking and crooked; the difference between frankness and shuffling.

Y. M. Explain.

O. M. The others offer you a hundred bribes to be good, thus conceding that the Master inside of you must be conciliated and contented first, and that you will do nothing at first-hand but for his sake; then they turn square around and require you to do good for others' sake chiefly; and to do your duty for duty's sake, chiefly; and to do acts of self-sacrifice. Thus at the outset we all stand upon the same ground—recognition of the supreme and absolute Monarch that resides in man, and we all grovel before

him and appeal to him; then those others dodge and shuffle, and face around and unfrankly and inconsistently and illogically change the form of their appeal and direct its persuasions to man's second-place powers and to powers which have no existence in him, thus advancing them to first place; whereas in my admonition I stick logically and consistently to the original position: I place the Interior Master's requirements first, and keep them there.

While training is helpful Mark Twain believes that man's dignity and the merit he acquires by being trained must be surrendered. The discussion continues on this subject as follows:

Y. M. Then you believe that such tendency toward doing good as is in men's hearts would not be diminished by the removal of the delusion that good deeds are done primarily for the sake of No. 2 instead of for the sake of No. 1?

O. M. That is what I fully believe.

Y. M. Doesn't it somehow seem to take from the dignity of the deed?

O. M. If there is dignity in falsity, it does. It removes that.

Y. M. What is left for the moralist to do?

O. M. Teach unreservedly what he already teaches with one side of his mouth and takes back with the other: Do right for your own sake, and be happy in knowing that your neighbor will certainly share in the benefits resulting.

Man has no more merit than the materials which we handle. For instance:

Here are two ingots of virgin gold. They shall represent a couple of characters which have been refined and perfected in the virtues by years of diligent right training. Suppose you wanted to break down these strong and well compacted characters—what influence would you bring to bear upon the ingots?....

Y. M. A steam-jet cannot break down such a substance.....

O. M. The quicksilver is an outside influence which gold (by its peculiar nature—say temperament, disposition), cannot be indifferent to. It stirs the interest of the gold, although we do not perceive it; but a single application of the influence works no damage. Let us continue the application in a steady stream, and call each minute a year. By the end of ten or twenty minutes—ten or twenty years—the little ingot is sodden with quicksilver, its virtues are gone, its character is degraded. At last it is ready to yield to a temptation which it would have taken no notice of, ten or twenty years ago. We will apply that temptation in the form of a pressure of my finger. You note the result?

Y. M. Yes; the ingot has crumbled to sand.

The instance of two ingots of gold is further explained by a story of two brothers, which is probably taken from some newspaper account. The Old Man says:

There was once a pair of New England boys—twins. They were alike in good dispositions, fleckless morals, and personal appearance. They were the models of the Sunday-school. At fifteen George had an opportunity to go as cabin-boy in a whale-ship, and sailed away for the Pacific. Henry remained at home in the village. At eighteen George was a sailor before the mast, and Henry was teacher of the advanced Bible class. At twenty-two George, through fighting-habits and drinking-habits acquired at sea and in the sailor boarding-houses of the European and Oriental ports, was a common rough in Hong Kong, and out of a job; and Henry was superintendent of the Sunday-school. At twenty-six George was a wanderer, a tramp, and Henry was pastor of the village church. Then George came home, and was Henry's guest. One evening a man passed by and turned down the lane, and

Henry said, with a pathetic smile, "Without intending me a discomfort, that man is always keeping me reminded of my pinching poverty, for he carries heaps of money about him, and goes by here every evening of his life." That outside influence—that remark—was enough for George, but it was not the one that made him ambush the man and rob him, it merely represented the eleven years' accumulation of such influences, and gave birth to the act for which their long gestation had made preparation. It had never entered the head of Henry to rob the man—his ingot had been subjected to clean steam only; but George's had been sujected to vaporized quicksilver.

A peculiar theory of Mark Twain is his idea that the mind is a machinery which is independent of man, as if there were no connection between what he calls the stern master or the impulse and the mentality of man. The mind works whether the master wants it or not. The Young Man asks whether man's mind works automatically and is really independent of control. The Old Man says:

It is diligently at work, unceasingly at work, during every waking moment. Have you never tossed about all night, imploring, beseeching, commanding your mind to stop work and let you go to sleep?—you who perhaps imagine that your mind is your servant and must obey your orders, think what you tell it to think, and stop when you tell it to stop. When it chooses to work, there is no way to keep it still for an instant. The brightest man would not be able to supply it with subjects if he had to hunt them up. If it needed the man's help it would wait for him to give it work when he wakes in the morning. . . . The mind is independent of the man. He has no control over it, it does as it pleases. It will take up a subject in spite of him; it will stick to it in spite of him; it will throw it aside in spite of him. It is entirely independent of him. . . . Yes, asleep as well as awake. The mind is quite independent. It is master. You have nothing to do with it. It is so

apart from you that it can conduct its affairs, sing its songs, play its chess, weave its complex and ingeniously-constructed dreams, while you sleep or wake. You have imagined that you could originate a thought in your mind, and you have sincerely believed you could do it.

Mark Twain reminds us of the well-known truth that sometimes we can not rid ourselves of jingles of melodies that haunt us, and claims that mind is just as independent in dreams as when awake. He compares the dream to a drama. He says:

Your dreaming mind originates the scheme, consistently and artistically develops it, and carries the little drama creditably through—all without help or suggestion from you.

Though the mind is independent man has the power to set it to work on the subject which pleases the mind. We read:

O. M. A man's mind, left free, has no use for his help. But there is one way whereby he can get its help when he desires it.

Y. M. What is that way?

O. M. When your mind is racing along from subject to subject and strikes an inspiring one, open your mouth and begin talking upon that matter—or take your pen and use that. It will interest your mind and concentrate it, and it will pursue the subject with satisfaction. It will take full charge, and furnish the words itself. . . . Take a "flash of wit"—repartee. Flash is the right word. It is out instantly. There is no time to arrange the words. There is no thinking, no reflecting. Where there is a wit-mechanism it is automatic in its action, and needs no help. Where the wit-mechanism is lacking, no amount of study and reflection can manufacture the product.

Y. M. You really think a man originates nothing, creates nothing?

O. M. I do. Men perceive, and their brain-machines automatically combine the things perceived. That is all.

Y. M. The steam engine?

O. M. It takes fifty men a hundred years to invent it. One meaning of invent is discover. I use the word in that sense. Little by little they discover and apply the multitude of details that go to make the perfect engine. Watt noticed that confined steam was strong enough to lift the lid of the tea-pot. He didn't create the idea, he merely discovered the fact; the cat had noticed it a hundred times. From the tea-pot he evolved the piston-rod. To attach something to the piston-rod to be moved by it, was a simple matter—crank and wheel. And so there was a working engine.

One by one, improvements were discovered by men who used their eyes, not their creating powers—for they hadn't any—and now, after a hundred years, the patient contributions of fifty or a hundred observers stand compacted in the wonderful machine which drives the ocean liner.

The animal mind is not different from the mind of man, only man's mind is more complicated but by no means superior. Shakespeare writes a drama borrowing from preceding ages. He puts this and that together. That is all he does and can do, but so does the rat. Concerning the rat Mark Twain says:

He observes a smell, he infers a cheese, he seeks and finds. The astronomer observes this and that; adds his this and that to the this-and-thats of a hundred predecessors, infers an invisible planet, seeks it and finds it. The rat gets into a trap; gets out with trouble; infers that cheese in traps lacks value, and meddles with that trap no more. The astronomer is very proud of his achievement, the rat is proud of his. Yet both are machines, they have done machine work, they have originated nothing, they have no right to be vain, the whole credit belongs to their Maker. They are entitled to no honors, no praises, no monuments when they die, no remembrance. One is a complex and elaborate machine, the other a simple and

limited machine, but they are alike in principle, function and process, and neither of them works otherwise than automatically, and neither of them may righteously claim a personal superiority or a personal dginity above the other....

Y. M. It is odious. Those drunken theories of yours —concerning the rat and all that—strip man bare of all his dignities, grandeurs, sublimities.

O. M. He hasn't any to strip—they are shams, stolen clothes. He claims credits which belong solely to his Maker....I think that the rat's mind and the man's mind are the same machine, but of unequal capacities—like yours and Edison's; like the African pigmy's and Homer's; like the Bushman's and Bismarck's.

Y. M. How are you going to make that out, when the lower animals have no mental quality but instinct, while man possesses reason?

O. M. What is instinct?

Y. M. It is merely unthinking and mechanical exercise of inherited habit?

The term instinct is meaningless. The Old Man says:

Now my idea of the meaningless term "instinct" is, that it is merely petrified thought; solidified and made inanimate by habit; thought which was once alive and awake, but is become unconscious—walks in its sleep so to speak.

For a further explanation of the thinking ability of animals the Old Man presents two instances concerning gulls supposed to belong to the most stupid animals.

Here is the experience of a gull, as related by a naturalist. The scene is a Scotch fishing village where the gulls were kindly treated. This particular gull visited a cottage; was fed; came next day and was fed again; came into the house, next time, and ate with the family; kept on doing this almost daily thereafter. But, once the gull

was away on a journey for a few days, and when it returned the house was vacant. Its friends had removed to a village three miles distant. Several months later it saw the head of the family on the street there, followed him home, entered the house without excuse or apology, and became a daily guest again. Gulls do not rank high, mentally, but this one had memory and reasoning faculty.

Here is a case of a bird and a stranger as related by a naturalist. An Englishman saw a bird flying around about his dog's head, down in the grounds, and uttering cries of distress. He went there to see about it. The dog had a young bird in his mouth—unhurt. The gentleman rescued it and put it on a bush and brought the dog away. Early the next morning the mother-bird came for the gentleman, who was sitting on his verandah, and by its maneuvers persuaded him to follow it to a distant part of the grounds—flying a little way in front of him and waiting for him to catch up, and so on; and keeping to the winding path, too, instead of flying the near way across lots. The same dog was the culprit; he had the young bird again, and once more he had to give it up. Since the stranger had helped her once, she inferred that he would do it again; she knew where to find him, and she went upon her errand with confidence. Her mental processes were what Edison's would have been. She put this and that together—and that is all that thought is—and out of them built her logical arrangement of inferences. Edison could not have done it any better himself.

Y. M. Do you think that many of the dumb animals can think?

O. M. Yes—the elephant, the monkey, the horse, the dog, the parrot, the macaw, the mocking-bird, and many others. The elephant whose mate fell into a pit, and who dumped dirt and rubbish into the pit till the bottom was raised high enough to enable the captive to step out, was

equipped with the reasoning quality. Dogs and elephants learn all sorts of wonderful things. They must surely be able to notice, and to put things together, and say to themselves, "I get the idea, now: when I do so and so, as per order, I am praised and fed; when I do differently I am punished." Fleas can be taught nearly anything that a congressman can.....As a thinker and planner the ant is the equal of any savage race of men; as a self-educated specialist in several arts she is the superior of any savage race of men; and in one or two high mental qualities she is above the reach of any man, savage or civilized.

Y. M. Oh, come! you are abolishing the intellectual frontier which separated man and beast.

O. M. I beg your pardon. One cannot abolish what does not exist.

Y. M. You are not in earnest, I hope. You cannot seriously mean to say there is no frontier.

O. M. I do say it seriously.

The Young Man objects that animals are dumb, but the Old Man flatly denies it. He says:

"Dumb" beast suggests an animal that has no thought-machinery, no understanding, no speech, no way of communicating what is in its mind. We know that a hen has speech. We cannot understand everything she says, but we easily learn two or three of her phrases. We know when she is saying, "I have laid an egg"; we know when she is saying to the chicks, "Run here, dears, I've found a worm"; we know what she is saying when she voices a warning, "Quick! hurry! gather yourselves under mamma, there's a hawk coming!" We understand the cat when she stretches herself out, purring with affection and contentment and lifts up a soft voice and says, "Come, kitties, supper's ready"; we understand her when she goes mourning about and says, "Where can they be?—they are lost —won't you help me hunt for them?" and we understand

the disreputable Tom when he challenges at midnight from his shed, "You come over here, you product of immoral commerce, and I'll make your fur fly!" We understand a few of the dog's phrases, and we learn to understand a few of the remarks and gestures of any bird or other animal that we domesticate and observe. The clearness and exactness of a few of the hen's speeches which we understand is argument that she can communicate to her kind a hundred things which we cannot comprehend—in a word, that she can converse. And this argument is also applicable in the Unrevealed. It is just like man's vanity and impertinence to call an animal dumb because it is dumb to his dull perceptions.....

In all his history the aboriginal Australian never thought out a house for himself and built it. The ant is an amazing architect. She is a wee little creature, but she builds a strong and enduring house eight feet high—a house which is as large in proportion to her size as is the largest capitol or cathedral in the world compared to man's size. No savage race has produced architects who could approach the ant in genius or culture. No civilized race has produced architects who could plan a house better for the uses proposed than can hers. Her house contains a throne-room; nurseries for her young; granaries, apartments for her soldiers, her workers, etc.; and they and the multifarious halls and corridors which communicate with them are arranged and distributed with an educated and experienced eye for convenience and adaptability. But let us look further before we decide. The ant has soldiers —battalions, regiments, armies; and they have their appointed captains and generals, who lead them to battle.

Y. M. That could be instinct, too.

O. M. We will look still further. The ant has a system of government; it is well planned, elaborate, and is well carried on.

Y. M. Instinct again.

O. M. She has crowds of slaves, and is a hard and unjust employer of forced labor.

Y. M. Instinct.

O. M. She has cows, and milks them.

Y. M. Instinct, of course.

O. M. In Texas she lays out a farm twelve feet square, plants it, weeds it, gathers the crop and stores it away.

Y. M. Instinct, all the same.

O. M. The ant discriminates between friend and stranger. Sir John Lubbock took ants from two different nests, made them drunk with whisky and laid them, unconscious, by one of the nests, near some water. Ants from the nest came and examined and discussed these disgraced creatures, then carried their friends home and threw the strangers overboard. Sir John repeated the experiment a number of times. For a time the sober ants did as they had done at first—carried their friends home and threw the strangers overboard. But finally they lost patience, seeing that their reformatory efforts went for nothing, and threw both friends and strangers overboard. Come—is this instinct, or is it thoughtful and intelligent discussion of a thing new—absolutely new—to their experience; with a verdict arrived at, sentence passed, and judgment executed? Is it instinct?—thought petrified by ages of habit—or isn't it brand-new thought, inspired by the new occasion, the new circumstances?

I will give you another instance of thought. Franklin had a cup of sugar on a table in his room. The ants got at it. He tried several preventives; the ants rose superior to them. Finally he contrived one which shut off access—probably set the table's legs in pans of water, or drew a circle of tar around the cup, I don't remember. At any rate he watched to see what they would do. They tried various schemes—failures, every one. The ants were puz-

zled. Finally they held a consultation, discussed the problem, arrived at a decision—and this time they beat that great philosopher. The formed in procession, crossed the floor, climbed the wall, marched across the ceiling to a point just over the cup, then one by one they let go and fell down into it! Was that instinct—thought petrified by ages of inherited habit?

Y. M. No, I don't believe it was. I believe it was a newly-reasoned scheme to meet a new emergency.

O. M. Very well. You have conceded the reasoning power in two instances. I come now to a mental detail wherein the ant is a long way the superior of any human being. Sir John Lubbock proved by many experiments that an ant knows a stranger-ant of her own species in a moment, even when the stranger is disguised—with paint. Also he proved that an ant knows every individual in her hive of 500,000 souls. Also, after a year's absence of one of the 500,000 she will straightway recognize the returned absentee and grace the recognition with an affectionate welcome. How are these recognitions made? Not by color, for painted ants were recognized. Not by smell, for ants that had been dipped in chloroform were recognized. Not by speech and not by antennae-signs nor contacts, for the drunken and motionless ants were recognized and the friend discriminated from the stranger. The ants were all of the same species, therefore the friends had to be recognized by form and feature—friends who formed part of a hive of 500,000! Has any man a memory for form and feature approaching that?

Y. M. Certainly not.

O. M. Franklin's ant and Lubbock's ants show fine capacities of putting this and that together in new and untried emergencies and deducting smart conclusions from the combinations—a man's mental process exactly. With memory to help, man preserves his observations and rea-

sonings, reflects upon them, adds to them, re-combines, and so proceeds, stage by stage, to far results—from the tea-kettle to the ocean greyhound's complex engine; from personal laber to slave labor; from wigwam to palace; from the capricious chase to agriculture, and stored food; from nomadic life to stable government and concentrated authority; from incoherent hordes to massed armies. The ant has observation, the reasoning faculty, and the preserving adjunct of a prodigious memory; she has duplicated man's development and the essential features of his civilization, and you call it all instinct!

Y. M. We have come a good way. As a result—as I understand it—I am required to concede that there is absolutely no intellectual frontier separating man and the unrevealed creatures?

O. M. That is what you are required to concede. There is no such frontier—there is no way to get around that. Man has a finer and more capable machine in him than those others, but it is the same machine and works in the same way. And neither he nor those others can command the machine—it is strictly automatic, independent of control, works when it pleases, and when it doesn't please, it can't be forced.

Y. M. Then man and the other animals are all alike, as to mental machinery, and there isn't any difference of any stupendous magnitude between them, except in quantity, not in kind.

O. M. That is about the state of it—intellectuality. There are pronounced limitations on both sides. We can't learn to understand much of their language, but the dog, the elephant, etc., learn to understand a very great deal of ours. To that extent they are our superiors. On the other hand they can't learn reading, writing, etc., nor any of our fine and high things, and there we have a large advantage over them.

Concerning the moral sense of animals the Young Man expects his old friend to make an exception in favor of man, but the Old Man prefers animals' morality to man's. He says: "I wasn't going to hoist man up to that." This is too much for the Young Man who claims that man at least has free will and a choice between different actions. He insists that while animals do their work according to their machine, man determines his decisions, and in doing so he exercises free will, but this choice Mark Twain claims is only allowed to the mind. Man's stern master would not allow free choice. Part of the discussion reads as follows:

O. M. The mind can freely select, choose, point out, the right and just one—its function stops there. It can go no further in the matter. It has no authority to say that the right one shall be acted upon and the wrong one discarded. That authority is in other hands.

Y. M. The man's?

O. M. In the machine which stands for him. In his born disposition and the character which has been built around it by training and environment.

Y. M. It will act upon the right one of the two?

O. M. It will do as it pleases in the matter. George Washington's machine would act upon the right one; Pizarro's mind would know which was the right one and which the wrong, but the Master inside of Pizarro would act upon the wrong one.

Y. M. Then as I understand it a bad man's mental machinery calmly and judicially points out which of two things is right und just—

O. M. Yes, and his moral machinery will freely act upon the one or the other, according to its make. His temperament and training will decide what he shall do, and he will do it; he cannot help himself, he has no authority over the matter....

There is will. But it has nothing to do with intellectual perceptions of right and wrong, and is not under their command. David's temperament and training had will,

and it was compulsory force; David had to obey its decrees, he had no choice. The coward's temperament and training possess will, and it is compulsory; it commands him to avoid danger, and he obeys, he has no choice. But neither the Davids nor the cowards possess free will—will that may do the right or do the wrong, as their mental verdict shall decide.

We note here that all decisions are spiritual. The Old Man corrects the Young Man as to his notion of materiality. He says:

There is no such thing as material covetousness. All covetousness is spiritual. The Master in you requires that in all cases you shall content his spirit—that alone. He never requires anything else, he never interests himself in any other matter.

Y. M. Ah, come! When he covets somebody's money—isn't that rather distinctly material and gross?

O. M. No. The money is merely a symbol—it represents in visible and concrete form a spiritual desire. Any so-called material thing that you want is merely a symbol: you want it not for itself, but because it will content your spirit for the moment. . . . There is that pathetic tale of the man who labored like a slave, unsatisfied, until he had accumulated a fortune, and was happy over it, jubilant about it; then in a single week a pestilence swept away all whom he held dear and left him desolate. His money's value was gone. He realized that his joy in it came not from the money itself, but from the spiritual contentment he got out of his family's enjoyment of the pleasures and delights it lavished upon them. Money has no material value; if you remove its spiritual value nothing is left but dross. It is so with all things, little or big, majestic or trivial—there are no exceptions. Crowns, scepters, pennies, paste jewels, village notoriety, world-wide fame—they are all the same, they have no material value: while

they content the spirit they are precious, when this fails they are worthless.

A peculiar notion of Mark Twain is his belief in the self-advertisement of all different nations, all agreeing in being possessed of a sanguine temperament. The main-spring in man's life is his temperament, his desire for happiness, not his intellectual reflections. Therefore there is no need of worrying about such a distressing doctrine as his philosophy that man is a machine. Mark Twain says:

A nation can be brought—by force of circumstances, not argument—to reconcile itself to any kind of government or religion that can be devised; in time it will fit itself to the required conditions; later, it will prefer them and will fiercely fight for them. As instances, you have all history: the Greeks, the Romans, the Persians, the Egyptians, the Russians, the Germans, the French, the English, the Spaniards, the Americans, the South Americans, the Japanese, the Chinese, the Hindus, the Turks—a thousand wild and tame religions, every kind of government that can be thought of, from tiger to house-cat, each nation knowing it has the only true religion and the only sane system of government, each despising all the others, each an ass and not suspecting it, each proud of its fancied supremacy, each perfectly sure it is the pet of God, each with undoubting confidence summoning Him to take command in time of war, but by habit able to excuse it and resume compliments—in a word, the whole human race content, always content, persistently content, indestructibly content, happy, thankful, proud, no matter what its religion is, nor whether its master be tiger or house-cat. Am I stating facts? You know I am.

Mark Twain admits that there are different temperaments, and these temperaments are inborn. They can be modified but not changed. His views are illustrated in two friends of the Young Man, one of whom he calls Burgess, the other one Adams. He says concerning them:

Their life-histories are about alike—but look at the

results! Their ages are about the same—around about fifty. Burgess has always been buoyant, hopeful, happy; Adams has always been cheerless, hopeless, despondent. As young fellows, both tried country journalism — and failed. Burgess didn't seem to mind it; Adams couldn't smile, he could only mourn and groan over what had happened, and torture himself with vain regrets for not having done so and so instead of so and so—then he would have succeeded. They tried the law—and failed. Burgess remained happy—because he couldn't help it, Adams was wretched—because he couldn't help it. From that day to this, those two men have gone on trying things and failing: Burgess has come out happy and cheerful every time, Adams the reverse. And we do absolutely know that these men's inborn temperaments have remained unchanged through all the vicissitudes of their material affairs. Let us see how it is with their immaterialities. Both have been zealous democrats; both have been zealous republicans; both have been zealous mugwumps. Burgess has always found happiness and Adams unhappiness, in these several political beliefs and in their migrations out of them. Both of these men have been Presbyterians, Universalists, Methodists, Catholics—then Presbyterians again, then Methodists again. Burgess has always found rest in these excursions, and Adams unrest. They are trying Christian Science now, with the customary result, the inevitable result. No political or religious belief can make Burgess unhappy or the other man happy. I assure you it is purely a matter of temperament. Beliefs are acquirements, temperaments are born; beliefs are subject to change, nothing whatever can change temperament.

This is the reason why no pessimistic philosophy can ever become dangerous. Mark Twain himself might have become a pessimist through the recognition of this sorry truth, but his temperament would not allow it. The discussion on the subject reads:

Y. M. Look at the matter as it stands now. Man has been taught that he is the supreme marvel of the creation; he believes it; in all the ages he has never doubted it, whether he was a naked savage, or clothed in purple and fine linen, and civilized. This has made his heart buoyant, his life cheery. His pride in himself, his sincere admiration of himself, his joy in what he supposed were his own and unassisted achievements, and his exultation over the praise and applause which they evoked—these have exalted him, enthused him, ambitioned him to higher and higher flights; in a word, made his life worth the living. But by your scheme, all this is abolished; he is degraded to a machine, he is a nobody, his noble prides wither to mere vanities; let him strive as he may, he can never be any better than his humblest and stupidest neighbor; he would never be cheerful again, his life would not be worth the living.

O. M. You really think that?

Y. M. I certainly do.

O. M. Have you ever seen me uncheerful, unhappy?

Y. M. No.

O. M. Well, I believe these things. Why have they not made me unhappy?

Y. M. Oh, well—temperament, of course! You never let that escape from your scheme.

O. M. That is correct. If a man is born with an unhappy temperament, nothing can make him happy; if he is born with a happy temperament, nothing can make him unhappy.

In conclusion we represent Mark Twain's explanation of the stern master which governs us, which is the "I," our ego or the "me." The Old Man says:

You perceive that the question of who or what the Me is, is not a simple one at all. You say, "I admire the rainbow," and "I believe the world is round," and in these

cases we find that the Me is not all speaking, but only the mental part. You say "I grieve," and again the Me is not all speaking, but only the moral part. You say the mind is wholly spiritual; then you say "I have a pain" and find that this time the Me is mental and spiritual combined. We all use the "I" in this indeterminate fashion, there is no help for it. We imagine a Master and King over what you call The Whole Thing, and we speak of him as "I," but when we try to define him we find we cannot do it. The intellect and the feelings can act quite independently of each other; we recognize that, and we look around for a ruler who is master over both, and can serve as a definite and indisputable "I," and enable us to know what we mean and who or what we are talking about when we use that pronoun, but we have to give it up and confess that we cannot find him. To me, man is a machine, made up of many mechanisms; the moral and mental ones acting automatically in accordance with the impulses of an interior Master who is built out of born temperament and an accumulation of multitudinous outside influences and trainings; a machine whose one function is to secure the spiritual contentment of the Master, be his desires good or be they evil; a machine whose will is absolute and must be obeyed, and always is obeyed.

Y. M. Maybe the Me is the Soul?

O. M. Maybe it is. What is the Soul?

Y. M. I don't know

O. M. Neither does any one else.

Y. M. What is the Master?—or, in common speech the Conscience? Explain it.

O. M. It is that mysterious autocrat, lodged in man, which compels the man to content its desires. It may be called the Master Passion—the hunger for Self-Approval.

Y. M. Where is its seat?

O. M. In man's moral constitution....It is indifferent

to the man's good; it never concerns itself about anything but the satisfying of its own desires. It can be trained to prefer things which will be for the man's good, but it will prefer them only because they will content it better than other things would. . . . It is a colorless force seated in the man's moral constitution. Let us call it an instinct—a blind, unreasoning instinct, which cannot and does not distinguish between good morals and bad ones, and cares nothing for the results to the man provided its own contentment can be secured; and it will always secure that. It is not always seeking money, it is not always seeking power, nor office, nor any other material advantage. In all cases it seeks a spiritual contentment, let the means be what they may. Its desires are determined by the man's temperament—and it is lord over that. Temperament, Conscience, Susceptibility, Spiritual Appetite, are in fact the same thing. Have you ever heard of a person who cared nothing for money?

In spite of Mark Twain's idea that no amount of theory will disturb man's happiness or his self content, he did not publish his book in his lifetime, and his motives for it are discussed at the end of his conversations, as follows:

Y. M. I have thought over all these talks, and passed them carefully in review. With this result. That—that—are you intending to publish your notions about man some day?

O. M. Now and then, in these past twenty years, the Master inside of me has half-intended to order me to set them to paper and publish them. Do I have to tell you why the order has remained unissued, or can you explain so simple a thing without my help?

Y. M. By your doctrine, it is simplicity itself: Outside influences moved your interior Master to give the order; stronger outside influences deterred him.

O. M. That is correct. Well?

Y. M. Upon reflection I have arrived at the conviction that the publication of your doctrines would be harmful. Do you pardon me?

O. M. Pardon you? You have done nothing. You are an instrument—a speaking-trumpet. Speaking-trumpets are not responsible for what is said through them.

Y. M. Well to begin: it is a desolating doctrine; it is not inspiring, enthusing, uplifting. It takes the glory out of man, it takes the pride out of him, it takes the heroism out of him, it denies him all personal credit, all applause; it not only degrades him to a machine, but allows him no control over the machine; makes a mere coffee-mill of him, and neither permits him to supply the coffee nor turn the crank; his sole and piteously humble function being to grind coarse or fine, according to his make, outside impulses doing all the rest.

O. M. It is correctly stated.

In connection with Mark Twain's condemnation of man's pride and his wrong claim to glory and praise, the Old Man gives all the credit of the accomplishments of man to God. Concerning the virtues of man the Old Man raises the question "Who manufactures them"? and the Young Man answers "God." In comment on this solution of the Young Man, the Old Man defends his position thus:

O. M. Where does the credit of it belong?

Y. M. To God.

O. M. And the glory of which you spoke, and the applause?

Y. M. To God.

O. M. Then it is you who degrade man.

Y. M. You have made a machine of him.

O. M. Who devised that cunning and beautiful mechanism, a man's hand?

Y. M. God.

The Old Man sees no wrong in taking the vainglory of the man out of him and crediting God with all blame as well as praise, and

he adds: "I am merely calling attention to the fact, nothing more. Is it wrong to call attention to the fact, is it a crime?"

Mark Twain's main argument as to the machinelike operations of the human mind is quite sound, but over the facts he casts a gloom which is of his own making. According to him the truth that man is a machine takes away from man all his dignity, for everything that man does, everything he thinks or invents or plans, comes to him from the outside, and the very start of man is due to outside influence; and this is perfectly true. It is the outside from which we gather our experience, and experience builds up man. Man appropriates the building-stones of his mentality from experience, and makes them his own. Man's mind is an echo of his law-ordained surroundings and reflects the universal order of the cosmos.

Mark Twain is right in saying that everything of our mind comes from the outside. Even our inborn tendencies have been built up by what the Buddhists call prior existences. They come to us by heredity and by education; there is nothing in us which we do not owe to the surrounding world. This is a truth which must be acknowledged, but we deny that it carries with it any cause for depression or melancholy. On the contrary we find that we are children of the universe and that the universe has produced us; or, to speak religiously, every one of the creatures of the universe is a child of God. And why should we therefore be alarmed at the idea that man is not original when we see that he is simply a child of the All from which he has sprung? This, it seems to me, is rather a cause for rejoicing than for a pessimistic outcry of despair. We will end our discussion of Mark Twain's philosophy in quoting a few lines from *De Rerum Natura*:

> "Thus ever do a thousand subtle threads
> Me intertwine with that surrounding world
> Wherein I move. I contemplate the Vision:
> Of me it is a part. I am the All;
> Albeit that which into Self hath grown
> Is of the world a part: This bides, I pass.
> But lo! e'en then, in that which unto me
> The not-I seemed, I evermore endure."

EDITOR.

THE MECHANISTIC PRINCIPLE AND THE NON-MECHANICAL.

MECHANICALISM AND TELEOLOGY—A CONTRAST.

TWO world-conceptions stand in a strongly marked contrast to each other. One is the mechanistic, the other the teleological, and the struggle between the two is quite severe. It appears that in the combat no quarter is nor can be given. The former conception is held mostly by scientists, by men of thought who are accustomed to rigid method, by believers in theory; the latter by men of action, by jurists, preachers, moralists, reformers, poets, and all those who deal with the human will in practical life, among them also by sentimentalists, by all those to whom hopes and wishes are arguments.

The facts of our experience seem to favor both views in two different realms; the world of inanimate nature is a world of rigid causation where the laws of mechanics rule supreme, but the world of human action seems to make an exception. In the domain of social relations, the will seems to interfere with the mechanical processes of things and a new kind of causation is introduced, the causation of purpose. All mechanicalism means rigid necessity while the causation of purpose is directed by design and provident forethought.

All life pursues a purpose; even the smallest ameba wants to live. Its aim is self-preservation, and this tendency to self-preservation characterizes all life. Each liv-

ing being, the lowest as well as the highest, possesses wants and attends to them. It endeavors to maintain and preserve itself and to propagate its kind; even the highest and noblest animal, man, can do no more, although his self-assertion will aim at the perpetuation of his better self, his ideals.

How are we to explain this contradictory character of the facts with which we are confronted? The scientist claims that the mechanistic principle is and must be true throughout, and we are not prepared to contradict his proposition. On the other hand man *does* plan and design, and his designs determine the future. Are our views of purpose in the domain of life illusions? We are told by some scientists that just as there is no freedom of will, but absolute determinism, so there is really no purpose but only the results of mechanical pressure. The teleological party, however, takes the opposite view and finds purpose everywhere. Even the world of push, the mechanical movements of the stars, are said to be dominated by the purpose of a creator, and our greatest poets declare that ultimately there is a supreme will that governs all.

No one will deny that the world is an orderly cosmos, that the domain of life is characterized by the law of evolution, that the successive stages in the developmnet of rational beings as well as the history of mankind are predetermined, and a contemplation of the facts verifies the drift of this sentiment. Schiller says:

> "And a God, too, there is, a purpose sublime,
> Though frail may be human endeavor.
> High over the regions of space and of time
> One idea supreme rules forever.
> While all things are shifting and tempest pressed,
> Yet the spirit pervading the change is at rest."

And the poet laureate of the Victorian age echoes a similar idea saying:

> "Yet I doubt not, through the ages one increasing purpose runs,
> And the thoughts of men are widened with the process of the suns."

This idea is deeply rooted in the human mind and it is a common conviction that if it had to be surrendered, life would lose its meaning and the world would be as dreary as a sterile desert; all our ideals would become empty dreams, religious comfort would be gone, art would become a vain show of sensuous beauty, and truth would change into an idle quest for a *fata morgana.*

The two propositions seem contradictory and yet we shall undertake to prove that in a certain sense both are rigorously true. On the one hand we claim that all causation is mechanical in the strict sense of the word according to the mechanistic principle; every cause is a motion, every result is accomplished according to conditions and circumstances by changes of place, and all processes that take place are transformations. On the other hand we accept the belief that not only men but even less highly organized creatures are purpose-endowed and above all that the regularities of natural laws, the lawdom of nature, is so intrinsic as to constitute evolution in both the inanimate and the organized domains of existence. This order of the universe is its most inalienable feature which shows itself in a definite direction of development, and in a growth with increasing purpose, a predetermined end or aim called *telos* in Greek, and though the world-order is not a man-made design, it may very well be compared to a plan and is analogous to a premeditated purpose; it acts like one and may be represented as such.

The philosophical term "teleology" is derived from the Greek word *telos* = "aim, end, purpose," and as a theory it assumes that there is design in the world. So far very little, if any, distinction has been made between the meanings "end" as the aim of a direction (in German *Ziel*) and "purpose" as a consciously designed end (in German *Zweck*), but such a distinction will be necessary. Everywhere in nature we see mechanically determined ends, but

not purposive designs. There is, as Germans would say, *Zielstrebigkeit*, a tendency to a predetermined end, but no *Zweckmässigkeit*, no purpose.

If the mechanistic principle is true, it stands to reason that every motion in the universe from the spinning of the tiniest atom to the development of the world as a whole must be dominated by regularity; everything must move in a harmonious order with unfailing consistency and toward a definite aim; or in other words the direction exhibited by all motion of the universe, its aim and end, its *telos*, is not superimposed upon it from the outside by an external power, an extramundane ruler, but is immanent; it is part and parcel of the cosmic constitution; it is as eternal as all the natural laws and is of an intrinsic character.

The mechanical laws of the world are applications of a general norm and this norm is the principle of consistency in motion. It did not originate, it is eternal; it is not God-made, it is part and parcel of God himself. What in religious language people call God, the ultimate authority of conduct, the standard of truth, the directive and formative factors of existence, is this eternal norm which constitutes the cosmic order. We might say that it is the irreversible will of deity which regulates not only this universe of ours but any possible universe. It is the law of nature as we know it, but it is also the law of any possible nature, and in this sense it is supernatural in the literal sense of the term.

PARTISAN SPIRIT.

The methods in the fight between the two opposing parties, the mechanicalists and the teleologists, have not been altogether fair. The representatives of the mechanistic theory generally ridicule the other party as unscientific. They belittle the significance of the human will and treat the consciousness of man's own importance and dig-

nity as a kind of megalomania. In comparison with the infinite expanse of the universe, how inconsiderable is this epiphenomenon of the human soul! Yet a great philosopher who wrote the first "General History and Theory of the Heavens," in which he expounded "the mechanical origin of the whole edifice of the world, according to Newtonian principles," in recognizing the contrast of the two views expresses his awe at two things: outside, the expanse of the starry heavens, and within the human soul, man's conscience. The former is a type of corporeal sublimity, the latter of the sublimity of moral greatness. This little and insignificant inner state within us, our own consciousness, our own will, our own aspirations, and last not least our conscience, the still small voice in man which tells him what he ought to do, affords a peep into the inside of nature. In man's soul appears the efflorescence of that enormous material universe, and here we have a revelation which shows us the meaning, or rather the end and aim, the *telos,* of all these motions and mechanical laws. There is no use in ridiculing the insignificance of this little epiphenomenon, or to declare its growth to be a result of chance; it is here and demands an explanation.

On the other hand the representatives of the teleological view are not less, but rather more, unfair than their adversaries. Many of them are preachers; they moralize and call their antagonists names. They denounce the mechanistic view as immoral, as irreligious, as lacking respect for everything higher and nobler, and treat it as an abomination. Forceful language is always impressive and has its advantages in argument, because it overawes with a show of authority, but if closely considered it never proves anything; on the contrary, it raises the suspicion that the cause for which it is displayed is not otherwise defensible. He who can convince his opponent by good arguments will

scarcely call him names. Only the man without reason turns rude.

As the mechanistic thinkers characterize man's spirituality as a kind of by-play, so the teleologists have only derogatory epithets for nature and the cosmic constitution. Both its laws and its forces are decried as "blind" and "brutal," and a machine is denounced as something utterly contemptible, an inferior thing that lacks intelligence and is dead. While it is true enough that a machine has no life in the sense of a living organism, we ought not to say that its mode of operation, the mechanism of its motion, and still less the mechanistic principle according to which it moves, is low or contemptible. On the contrary a machine is a triumph of mind, and it utilizes that grand constitution of the cosmos, its mechanical law, for a certain purpose which serves human needs. The laws themselves which are applied in the construction of machinery and which machines blindly obey have no eyes as human creatures have, but it would be wrong to have them characterized as blind. We might as well say that mathematics is dumb and dull because there is not any mathematics in itself possessing ears and the faculty of speech or other qualities of a living person. We know that it has not the consciousness of mathematical theorems after the fashion of a professor. Surely it is wrong to denounce these laws in terms of contempt. If we do not understand how to make a proper use of them, they are not brutal, but we are lacking in intelligence and suffer from our own shortcomings.

The theist's accusation that the laws of nature are brutal might be turned against his anthropomorphic God with much greater propriety, for if the forces of nature are brutal in allowing terrible accidents to happen in which many lives are lost, what shall be said of a God, endowed with an ego-consciousness and expecting to be worshiped by his creatures as all-wise, all-good, all-merciful, and also

as all-powerful? The forces of nature are forever the same, they serve the thoughtful if used properly, they destroy the thoughtless who do not utilize them to advantage. But think of a father who watches his children and allows them to drown without a warning, to be wrecked in foolish ventures, to burn to death or to perish in innumerable ways —simply for mysterious, presumably educational reasons! If that be the action of a fatherly God, of a God who in human fashion with a clear omniscient consciousness knows what he is doing, how shall we characterize his providence after having denounced natural forces as brutal?

The laws of nature are certainly not personalities, as the Greeks describe their gods in myth and fable. But while we do not believe that generalizations are conscious beings, we know that certain configurations of conditions produce results of a definite kind and the so-called laws of these conditions are truths; they are certain norms in the objective world, in the world of realities. These norms are highly significant as efficient factors which in the wide illimitable range of our experience have never belied our confidence in them; they determine the uniformities of phenomena with an intrinsic necessity; they make the world intelligible and are therefore illuminating. As they do not obscure the world but guide the course of nature, the word "blind" is misleading. Remember that these blind brutal norms of nature have produced the rationality of man, his foresight and his humanity.

The mechanistic idea is a demand of science which cannot be refused. If causation prevails at all it must be mechanical, but it has taken mankind thousands of years before this consequence of mechanicalism as a universal principle was stated in plain terms, and the first thinker who ventured to pronounce it clearly and boldly was Julien Offray de la Mettrie.

La Mettrie wrote a book entitled *L'homme machine* (published in August, 1747[1]), in which he defends the proposition that man is a machine in the sense in which Descartes had claimed that animals are automata.

La Mettrie's book is wittily written, but its arguments are somewhat crudely presented and we can not say that the author has handled his thesis in the proper spirit. He does not enter into the finer problems of intellectual and ideal life, and has not without reason been accused of vulgarity. Nevertheless we must recognize the boldness of his thought, and the heroic stand which he takes on a subject which was extremely unpopular and subjected the author to much persecution.[2]

La Mettrie's book shocked the world; its author was almost universally condemned and the book itself was denounced as the most infamous production of the human brain. Only a few great minds, foremost among them Frederick the Great, stood up for the lonely freethinker.

La Mettrie's proposition was by no means absolutely new, for the mechanistic principle is an old scientific ideal. The oldest philosophers we know of, the Ionian physicists and also Heraclitus, Democritus, Leucippus, and Epicurus, attempted to construct a world-conception on scientific grounds and to explain the origin of the cosmos on mechanistic principles. It is a consistent conclusion of thought to explain everything mechanically, but our scientists were not always conscious of it as the *sine qua non* of a scientific comprehension. Among the Romans the philosophy of Epicurus was upheld by T. Lucretius Carus in his well-known philosophical poem *De Rerum Natura,* but Cicero in his many writings repudiated both Epicurus and Lucre-

[1] The imprint on the title page reads 1748. See Bergmann, *Die Satiren des Herrn Maschine,* p. 14.

[2] La Mettrie's little book *L'homme machine* has been recently published in French and English by the Open Court Publishing Company, under the title *Man A Machine.*

tius and treated them with contempt as if they were below refutation. In consequence of this unpopularity the works of Epicurus are now lost while the poem of Lucretius has probably survived only because of its literary merits.

During the Middle Ages the scientific method of explaining life was entirely extinct, but with the Renaissance, the mechanistic conception began gradually to revive. Leonardo da Vinci seems to have seen its significance and Descartes actually speaks of animals as living machines, without however drawing the consistent conclusion that if animals are machines man himself must be a machine too. Here, however, he halts, and while he claims that man has a soul, by which he understands a kind of super-mechanical principle, he regards all other animals as soulless.

The mechanistic conception also found a most prominent supporter in Kant, who wrote his famous book on the "History of the Starry Heavens" in which he claims that, given matter in any chaotic state, he would show how on the principle of Newtonian laws an orderly world like our own would develop from it.

Kant discussed the problem of the relation of God to mechanical laws but it would take too much space here to enter into details, nor would a discussion of the subject be profitable in so far as Kant's conception of God has not been clearly defined.[8]

In modern times many scientists, among them, e. g., Jacques Loeb of New York, have taken the same stand as La Mettrie, and we will mention also that Mark Twain, America's greatest humorist, has joined their cause. We do not hesitate to say that progress in scientific discovery

[8] In defending the mechanistic explanation Kant does not deny God, but his explanations are stilted and difficult to condense. He opposes vigorously the view held by Epicurus and other materialists that the world order is the result of chance. In Gustav Wegner's *Kantlexikon* extracts on the subject appear on p. 239 (No. 338) under the caption *"Die Welt von Gott belebt oder ein Gott in der Maschine."*

and in the explanation of nature's deepest problems is possible only by a strict adhesion to the mechanistic principle.

MOTION AND MOVEMENT.

Let us distinguish between motions and movements. By movements we understand the passive condition of being moved, while by motion we understand an active push. There is a common view that purely physical nature has no self-action, that it is moved. A horse or an animal may move about by its innate power, while a cart is being moved by the pull of the horse. The horse is alive, the cart is dead, and the changes which we observe in purely physical nature are frequently interpreted to be movements not motions. But is this really the case?

The chemical combinations of atoms according to their affinities are active motions in which different elements join, not because they are pushed by a power from the outside, but because in their innate nature they possess a tendency to combine with definite other atoms, and one affinity is overpowered by another stronger affinity, so that atoms far from being pushed and passively pressed into combinations, are themselves actively pushing; they seek and flee each other under definite circumstances according to definite laws, which laws however are nothing but general formulas descriptive of the character of the atoms. The atoms are the actors in this case, and the laws of nature simply describe what the actors will do under definite conditions. We have good reasons to believe that the affinities of the various elements will have to be explained ultimately from the forms of the atoms.

We will here incidentally remind the reader that the name "laws of nature" is really a gross misnomer. The laws of nature are formulas; they are descriptions, generalizations, or uniformities. They are called laws because formerly they were supposed to be enactments of a ruler,

they were thought to be the ukases of a czar, or the Good Lord's police regulations. But they are not laws superimposed upon the phenomena which they describe. The laws of nature do not compel things to act, but they are merely formulas of human invention, contrivances to characterize things, and to describe in general terms what certain things, chemical elements or what not, will do under definite conditions. The word "law" is an inappropriate term and has proved misleading because it suggests the idea that all things in the world suffer under the compulsion of an outside power, whereas in fact the several objects of existence do the acting themselves, and their acting is uniform under the same conditions. Things act, and the so-called laws of nature describe, they do not compel. Things act as they are, and they act of themselves in agreement with their own nature, not because there is a *vis a tergo,* a mysterious power that pushes them.

In the realm of living beings analogous conditions prevail; the cat will catch mice because that is her nature, and the bird of prey will swoop down upon the quarry, not because he is under compulsion, but because he is hungry and wants a breakfast. A thief will steal whenever the opportunity is offered, and an honest man will act honestly in accordance with his principles. There is no law nor any metaphysical agency, that forces them to act; they act in a special way, because that is their desire. All things will act according to their nature unless artificially interfered with, and it will be obvious that all motions are the expressions of the nature of things which move, while all movements originate by a transference of energy. The objects on which motions act are in a passive state; in their movements they suffer interference by an outside force. All *motions* are free, which means they result from the nature of the acting things; all *movements* are due to compulsion and both take place with mechanical necessity.

It becomes obvious that while there are movements in the world there must also be motions, for every movement is caused by a motion. Movements could never originate from themselves. The thing being moved suffers violence by another thing which does the active moving. Where a motion takes place there must have been a certain amount of stored up energy that is set free by some cause or other, and wherever there is a movement it must have acquired its momentum from a motion. Accordingly the ultimate start of the world in its simplest and most rudimentary beginning, must be due to a motion and can not have been a movement. Gravity can not be due to a push from the outside as Lesage tried to explain it. If however Lesage's interpretation were right, the pushing corpuscles would be the actors endowed with an intrinsic power of motion. The ultimate cause of the start of the world process—if there was any definite start at all, if the world process is not eternal—may have been the contraction of the ether into molar matter, into atoms first of the lighter, then of the heavier elements, as we see them originate in some stellar nebulas. Assuming that this contraction is a commotion in the primordial world-stuff it will naturally cause movements by pull or push, and the whole world becomes a combination of motions and movements.

One difference between a machine and a living organism is exactly this, that a machine makes movements while an organism manifests itself in motions; but both are mechanical and the law according to which they move is in either case in rigid agreement with the mechanistic principle. Closely considered this means nothing more than that there are no haphazard motions but everything that moves is regulated in its activity by harmonious uniformity.

Schopenhauer declares that the fall of the stone is practically the same as the will of man, and we do not hesi-

tate to say that the will of man is an incipient motion accompanied with consciousness; it is a tendency in an organism to move, it is the decision to do a certain thing. The difference between an act of the will and the fall of a stone is simply this, that the stone moves purely by gravity, while the will of man is determined by a motor idea, by a thought of accomplishing a purpose; and this motor idea is a tendency within the man, not a pressure outside of the man. It is a push from within, not a pull from without, and since both the fall of a stone and the will of man are incipient motions, we can with a poetical license allow Schopenhauer's saying to stand that the stone has the will to fall; only the stone is unconscious, while a man in action is pushing consciously. In him the motor idea acts as much as gravity in the falling stone, and both act according to mechanical laws—the laws of motion.

In line with Schopenhauer's idea that gravity is to be classed together with the will of man, we may conclude that gravitation is inexplicable except on a teleological principle, that gravitating bodies have a certain will, that they are not driven, not passively pushed, but that they actively push with an inherent energy towards an aim, and we can not help thinking that in a certain sense this is true. At any rate we are inclined to regard gravity as a motion, not as a movement.

Among the explanations of gravity we see only one which seems tenable; namely that all matter has originated by a condensation of the ether, the ether being the original material from which the world has been knitted into a sense-perceptible form. Now if the ether is, as is generally assumed, a continuous and immeasurably elastic medium, and if atoms, or perhaps even their ultimate constituents, ions, or electrons, or whatever we may call them, are little whirls producing some condensation, we are driven to the conclusion that the ether surrounding every such

condensation is thinned out, and so every tiny whirl produces a tension all around its center—which tension, according to *a priori* considerations of the nature of space, must exert a stress in the surrounding ether on all other such centers of concentration in direct proportion to the amount thus concentrated and kept in tension (constituting mass) and the inverse square of their distance; and this fulfils the conditions of the Newtonian law of gravitation.

If this be so, all matter is but a form of ether, due to condensations accompanied according to mechanical laws, with attenuations causing the tension between the contracted portions. Matter would thus have originated through the resistance which the ether offers to a commotion whirling through its immeasurable ocean. Matter then would not be dead stuff, but must represent an active reaction, in which its latent qualities are set free, and gravity would be a motion, not a movement. It would ultimately be a strain between two or more centers exercising a pull, and this pull would not come from the outside but reside in the strained condition of the contracted ether masses.

The tension would neither proceed from the masses alone nor reside in them alone, it would prevail in the whole system. The cause of the origin of mass producing the tension between masses might be compared to a cramp in the ether. This theory presupposes that the whole world, the whole ether-saturated ocean of existence, is one great coherent system of whirls, and necessarily the state of strain in this immeasurable ocean of ether would be simultaneous, which means the strain obtains between two or more or immeasurably many centers of gravitation, and wherever there are changes through a changed interrelation the whole strain changes simultaneously. There is not a change at one end which is transferred to the other end; the entire state changes and affects both ends, indeed

all ends, at once. Hence we may expect gravitation to be a force which is simultaneous in its action; or in other words, gravitation does not take any time to travel from place to place.

We are driven to the conclusion by *a priori* reasoning that ultimately there resides in all reality, and indeed in every particle of existence, an active power which moves and asserts its own being according to the form of its nature. It stands to reason that such is the case, only we must bear in mind that an intrinsic and positive self-motion should not be regarded as arbitrary, but as conditioned by its own form and surroundings, which relations are mathematically determinable. The principle that everything is moved by a push from the outside, by a *vis a tergo,* and that all things are inert and are moved about in a passive state is unthinkable.

We see in the world-play a self-activity which must have been active from the very beginning, and we feel compelled to believe that the very simplest and most primitive, the primordial commotions which start the origin of siderial systems, must be intrinsically autonomous or self-moving. There is an innate tendency of motion, a *vis viva* as former physicists used to say, in all existence and there is nothing real that is not actuated by such an inherent power.

THE WILL.

In the world of human life there is a distinction similar to that in the realm of physics. The real active will is an incipient motion, but there are also movements; and by movements in the domain of organized life we understand the actions of those who are influenced by others, the people whose minds have been taken captive by a leader. It is a special art to guide great multitudes and inspire them with

a motor idea that may turn out to be a powerful event in human history.

It is sometimes just as difficult to distinguish between motion and movement in the world of life as in the world of physics, and so it happens frequently that the very leaders have received their impulse from others, from their predecessors. Here too it might seem at first sight that there is only movement and no motion whatever, for all motor ideas have been impressed from the outside; and on analyzing the most original leaders in the world's history we shall be able to trace the sources of their ideals. The exponents of world-movements are mostly the results of the movements which they lead, not their causes. A certain need produces a want. The want clamors for relief and grows into a demand and the demand finds a spokesman for reform. Mostly it is true that while we think we are pushing, we are being pushed, as a German saying runs, *Du glaubst zu schieben, und du wirst geschoben.*

Nevertheless what is true of the physical world is true of the world of human endeavor. All movement presupposes motion. There must be a source of active energy back of any passive movement.

What is superimposed from the outside by an extraneous influence is not the energy of a movement but its direction. There are great amounts of energy stored up in the multitudes of the people, and wherever there are reasons for discontent their minds become inflamed and they can easily be guided by promises and the expectation of the fulfilment of their hopes.

The presence of the will in the souls of men is not a theory but a fact, and those who have to deal with people in a practical way and in actual life know it and act accordingly. Therefore the teleological view finds defenders among men of a practical turn of mind. They take into account aspirations, intentions, hopes and fears; they lead

and direct them as they deem desirable; they scarcely investigate the nature of the will, but they know that it exists; they take account of it as if there were no hitch in an intellectual comprehension of the will.

According to the nature of different impulses historic movements are guided or battled against, suppressed or favored. Considering that this is a fact of experience, who will deny the existence of the will, of human endeavor, and other teleological phenomena? We need not hesitate to say that will and purpose are a matter of direct experience in the world of human life; or can we really declare that all our longings and desires are mere illusions? Can it be true that we imagine that we act ourselves while in truth we are acted upon by impulses as by a *vis a tergo,* just as the wheels of an engine are turned by steam? We answer that the will in man is no fiction; it is a real and actual force; it is the motor power in us, but it moves with machinelike precision. This may seem paradoxical, but it is not, and to explain this paradox is the main problem of modern thought; in fact this has been the great question of philosophy ever since science dawned upon mankind.

The main trouble rises from the great interests that are at stake. If man is a machine, or less figuratively spoken, if all his actions are mechanical, i. e., subject to the same laws as machinelike motions, does he not cease to be accountable, does he not sink to the lowest level of inanimate nature, and does he not lose his dignity as a man, as a creature developed in the image of God, an incarnation of the deity? This fear has bewildered even sober thinkers and produces an otherwise inexplicable confusion of thought, so as to excogitate on the most flimsy arguments theories of the nature of man as different from other creatures, so that man's actions are believed to be of a mysterious supernatural kind and not subject to the universal laws of motion.

We believe, and if we wish to be consistent we can not help believing, that all motions in this world, and in any possible world, move in agreement with the laws of motion. In other words, all phenomena of motion take place according to the mechanistic principle. This is really a tautology; motions are mechanical and the atoms of a brain move and can not help moving in a definite way prescribed by the laws of motion, just as a stone falls to the ground and as the comets sweep through the heavens in perfect agreement with the laws of gravitation. However this truth is not contradicted by the fact that every living being, and especially man, is endowed with purpose.

In the history of mankind all our movements of reform, all our life and almost every detail of intellectual activity is purposive. We make ideals and we follow them up, we fight for them, and we accomplish our aims or fail. We see in the whole world of living beings a new creation of intellectual aspirations, resting upon the purely physical domain of existence. Will is not a mere delusion but it is a positive and undeniable fact.

We have devoted much thought to the problem and have reached a definite, and in our opinion, a final solution. Here in the face of these two contrasts we will outline our position as briefly as we can.

THE NON-MECHANICAL.

We have always been careful to say that the laws of mechanics apply to all motions, and we add now that they do not apply to conditions, or states, or qualities of things and thoughts which are not motions.

The mechanistic scientist as a rule overlooks the truth that although all phenomena of motion are determined by the laws of motion, there are features in this world which are not motions. As such features we designate mainly the entire psychological realm of feeling, and in this realm of

feeling there lies the domain of mind, viz., the significance of feeling.

First of all, what is a motion? A motion is a change of place, and changes of place belong to the objective realm of bodily things. So far as we are bodies we move about, but so far as we consist of sentiments and thoughts, motion has nothing to do with the nature of our soul.

Now we will ask, what is feeling? One thing must be granted: Feeling is not motion and motion is not feeling. We can not by any amount of logical or dialectic somersaults derive feeling from motion, nor motion from feeling. Things which originate from combination can not possess qualities which are alien to the whole class. A machine can not move unless there is a source of energy, and an object can not have weight unless its parts are material. New qualities originate, but they originate by combination and according to the laws of form. In Buddhist philosophy such structures are called in Pali *Sankhāra,* and in Sanskrit *Saṁskāra,* which has been quite properly translated in German *Gestaltung,* and in English "conformation."

The disparity between motion and feeling was recognized very clearly in ancient India in both religions, Brahmanism and Buddhism. The truth that motion is not feeling, and feeling is not motion, is explained by the example of a lame man and a blind man. The two go traveling together, the blind man with sound limbs (representing motion or objectivity) can move about and he takes the lame man (consciousness or subjectivity of feeling) upon his shoulders to direct him in his motions. Neither could travel by himself alone, but the two together mutually serve each other.[4]

From such considerations of the disparity between motion and feeling modern thinkers (I mention here first of

[4] *Visuddhimagga,* Chap. XVIII. Subjectivity is called "name" and objectivity "form." Both together (called "name-form" or in Pali *namorupo*) constitute the personality of man.

all Clifford) have, quite independently of the philosophers of ancient India, come to the same conclusion that feeling can not have originated from either matter or motion, but its conditions must have existed in a latent state in the nature of existence from the beginning. In other words, matter can not be merely the inert mass, and motion the dead change of place they appear upon superficial observation, but must contain the condition of consciousness, the germ of life as it blossoms forth in sentient creatures.

Leibnitz called attention to the radical difference between psychic states and objective bodies. If we could look into a brain, and could have it magnified so as to be able to watch the cerebral mechanism, yea if we could have it so greatly magnified that we could walk into the nervous structures and trace the processes of thought, we would see particles jostling one another and the impressions received would be similar to those which we have when inspecting a mill or the complicated machinery of a factory, but we would see only motions of material particles, we would nowhere detect feelings, or thoughts, or sentiments.

And why could we discover not the least trace of feelings? Simply because feelings and sentiments and thoughts are subjective phenomena; they are inner conditions, they are states of awareness. What our senses can see and observe and recognize are only objects and objective processes, and these processes will always present themselves as matter in motion. If a guide accompanied us through the factory of a human brain, he might tell us what the different functions accomplish. Let us assume that he would say, "Where the machinery begins to glow and emits a dim light, the activity of the jostling particles acquires awareness, and in yonder place where this glow accompanies the motion that starts the machinery of certain muscles, there are the operations of purposive will." In this way we might learn to decipher the meaning of the

several motions, but for all that we would neither see will, nor awareness, nor purpose.

Meaning is the most subtle quality with which feeling can be endowed and just as other feelings are impalpable and invisible, so meaning can never be an object of sense. If we read a book we decipher the letters and the words. The printed letters are symbols which reveal their meaning to the initiated, but the meaning itself is not a material nor a mechanical quality, and therefore by no chemical analysis of the paper or the printer's ink could the least trace of the meaning be discovered. Mind alone can decipher meaning in the symbols which it ensouls.

The physical phenomena which we observe in the objective world are objective, but feelings are subjective, and thus we must recognize that objective existence is not all of nature. There is another aspect which is the psychic side of it, the inside of things; and this inside, this subjectivity of existence, furnishes the elements from which under given conditions feelings originate.

These two features, feeling and motion, have sometimes been described as parallel to each other; and sometimes feeling has been called an epiphenomenon of objective reality; and again the two have been treated as identical, as one and the same thing, either with a spiritualistic or a materialistic tendency.

If the argument of the parallelism of feeling and motion is reliable, we must assume that on the one hand every objective existence possesses a subjectivity of its own, however low it may be in the purely physical domain; that on the other hand every subjective state has its objective realization, and the two correspond exactly, for they are the two aspects of one and the same thing, as are the inside and the outside of a curve. We look upon them as not the same but as inseparably belonging to each other, as analogous, as two different aspects of one and the same reality.

In a perfected state of physiology, we may be able to trace the transformations that take place in cerebral processes, and thus we may, on inspecting the commotions in the brain, mechanically explain how one feeling originates after another, and how the same forms of cerebral activity are associated with the same kinds of feelings, but we have no means of explaining mechanically the nature of feelings. The ophthalmologist for instance may trace the different states of color sensations, but on the one hand he will find no trace of the idea of motion in either red, or green, or yellow or other color sensations, and on the other hand the various forms of motion in the ether waves contain nothing of feeling. There is a correspondence, but the two corresponding sets are intrinsically different. We have a combination and also a cooperation of the lame man who can see and the blind man who can move. The former apperceives, the latter moves. In the domain of psychic phenomena, the mechanistic principle is checked, for mechanicalism can not trespass on grounds which in themselves are not motions. But for all that we can range the two sets of phenomena, the subjective states and the objective processes, in parallel columns side by side, and if the lame man can not walk he can *direct* the steps of his blind associate.

We will illustrate the situation by comparing the brain to a book. The spirit of the living brain consists in the meaning which the several feelings possess, and the spirit of a book is of the same kind. Meaning is an impalpable something; it is neither material nor mechanical, yet it is the main portion of a living person and of a book. Meaning is, as it were, the stuff of which spirit consists. Meaning is a factor in life the import of which consists in its tendency to signify and classify, to denote, to explain, to impart direction, to guide. The vehicle by which meaning conveys itself and renders interaction between two or more

minds possible is the symbol. Symbols stand for something; they are representative; they possess meaning, and the soul is a system of sentient symbols. There is nothing mysterious in the representativeness of symbols and yet the whole domain of spirituality rises from meaning; from this non-material, non-mechanical, non-quantitative, intangible phenomenon of picturing something else. Analyze a book, you can not discover its meaning in the most minute products of the analysis in the chemist's crucible. Dissect the brain of a man, you will never find his soul in the dissected parts. Measure all the motions of the nerves by the most delicate reaction apparatus, you will never lay bare the feelings themselves and still less that most subtle thing, the significance of feelings. We can measure everything that is objective, even the intensity of nerve reactions, but we can not measure what is not quantitative; we can not measure the qualitative values of subjective states.

TIME AND SPACE.

If a sentient being has developed into a thinking being through changing its sensations into representative feelings, it will in the course of time through the regularity of sensations acquire an expectancy of other feelings which will follow in a normal and consequential course, and thus the regularity of events due to the uniformity of natural phenomena will produce an anticipation of the future. Night always follows day, winter follows summer, and the succession of events is regular in innumerable other respects. Thus a living creature even at an early stage of its evolution gains the power of prognostication; it will form an idea of future events, and will naturally adapt itself to their arrival in a purely mechanical way.

We must insist, however, that an anticipation of the future is a thought which exists in the present. It is not the morrow which shapes the present, as says a prominent

teleologist,[5] but it is the *thought* of to-morrow which influences our action in the present. The thought of to-morrow has reference to the future, but under no pretext can we say that it belongs to the future, or that it takes place in the future, or that it is the future itself. It is based upon the past, and is part of the living present. The past is not dead, but is continued in all its efficacy in the present. It has shaped the present, lives on in the present, and the anticipation of the future is an outcrop of past experiences. In this way future events in a purely mechanical way cast their shadows before them, and thus purpose can and does originate in a mechanical universe.

The character of time is the succession of events, and the order of succession makes measurement possible. Measurement is a mental tool, invented for the sake of determining duration. The duration which is needed for the change from one event to another is expressed in units of time. The actuality before us is experience, i. e., events, transformations, successive changes, and the measurable duration of these successive changes is presented in our mind as time. Time, accordingly, the method of perceiving and determining duration, is ideal, while duration, the process to be measured by time, is actual.

The adjective "ideal" means partaking of the nature of ideas, implying that it is not an objective thing, but belongs to the realm of abstract thought.[6]

Time is only one abstract notion derived from the actuality of our experience, the other purely formal notion of objectivity is space. Space is in every respect analogous to time. Time is ideal, so is space. As time is eternal, so space is infinite. As time is constituted by the successive moments of motion and implies the possibility of meas-

[5] Prof. W. B. Smith in his article published in *The Monist* for January, 1913, p. 33.

[6] What is "ideal" need not be purely subjective. Compare the writer's book *Kant's Prolegomena*, pp. 186, 206, 214 *et passim*.

uring duration, so space is the field of motion and space yields us the opportunity of measuring distances. Time is as empty as space. Neither time nor space are concrete entities. They are not objects, not things, but relations, space being the juxtaposition of things and time the sequence of events. They are potentialities of action, and being potentialities they possess no limits, hence we call them infinite and eternal.

Schopenhauer looks upon time as that something which moment for moment renders futile everything under our hands. Time and the transitoriness of things frustrate all existence, and so time constitutes the vanity of all things. Schopenhauer says (*Parerga und Paralipomena*, II, § 143): "What has been, no longer is; it is no more than what has never been. But everything that is, in the next moment has already been. Therefore the most insignificant present has an advantage in its reality over the most important past, to which it stands in the relation of something to nothing."

This view is ingenious and sounds like a profound truth too true and too well known to deserve a restatement, and yet Schopenhauer misunderstands the nature of time. He looks upon time as an infinite series of isolated moments. Some of these, the past, are dead; they have existed but exist no longer and will never exist again. Others, the future, are not yet and never will be. Only the present, hovering between the two, is actual, and this present is vanishing under our hands. It has just come, and the next moment it will be no longer. Thus all is vanity.

Schopenhauer continues: "We enter existence suddenly to our own amazement after not having existed during countless millenniums, and after a short time we have as long a time again not to be. This is not at all right, says the heart; and even in the crude intellect a presentiment of the

ideality of time must arise from considerations of this kind."

Perhaps the heart is right in another sense than Schopenhauer means. His idea of the ideality of time is metaphysical. It implies that the present which is constantly vanishing is not real, but that some non-temporal eternity beyond time and space contains true existence. This is Plato's conception and it is true enough if it is understood as a poetic and allegorical representation of a great truth. But Schopenhauer, in looking upon the moments of time as separate items, draws a conclusion which Plato would not have endorsed. Schopenhauer declares that the past is gone as if it had never been. If that were true, why does the thoughtful man consider the future? Why does he not live exclusively in the present and enjoy the passing moment? Why should we trouble our children with school and the tedious work of their lessons? The truth is that the work done in the past is not gone as if it never had been, but remains with us, in the shape of blessings or curses. For the past is not dead; it lives on in the present and will continue in the future forever afterwards.

Like so many others, Schopenhauer forgets that the three aspects of time, past, present and future, do not consist of disconnected moments, that the three are one. He descants on the doctrine of the non-existence of the past and the illusory existence of the future, saying (§ 144): "Our existence has no basis nor ground on which to stand except the vanishing present. Thence it substantially has the constant movement towards assuming form without the possibility of the rest for which we continually strive. It is like the course of a man running down a mountain side who would fall if he tried to stop and can keep his footing only by continuing to run; likewise it is like a stick balanced on the fingertips; it is like the planet which would fall into the sun as soon as it stopped hastening uninterruptedly on

its way. Hence unrest is the type of existence. In such a universe where no stability of any kind and no permanent condition is possible, but where everything is seized in a restless whirl and change, where everything is hastening, fleeing, holding itself upright on the tightrope by constantly marching and moving, happiness is not in the least conceivable. It can not dwell where Plato's 'constant becoming and never being' may alone be found. First and foremost, no one is happy, but each strives his whole life long after a so-called happiness which he seldom attains and then only to be deceived; generally, however, each one finally puts into port shipwrecked and unrigged. But then it makes no difference whether he has been happy or unhappy in a life composed merely of a transitory present which is now at an end."

While it is true enough that restlessness is the type of existence, it is not true that it makes no difference what a man has done or experienced in life, whether he was happy or unhappy, whether he accomplished something good or evil; for we repeat that the past is not absolutely dead and the several moments of our life are not disconnected items which are gone as if they had never been. For the past endures in the present as a living factor, and the present continues in the future.

There are not three separate times: past, present and future; there is one time: it is eternity, for eternity lives in the unfoldment of time. The past is not eternally dead, the past dominates the present, it has formed the present, it continues to live in it and constitutes its character; the future is not, as has been claimed "never here"; the future is the present in its becoming, it is the living foetus in the womb of time; it is its bud before a full unfoldment. Like the past so the future is an essential part of the present, and in this way the Janus-headed time constitutes a trinity which is an indivisible unity with three aspects.

Time is the ever living present with one face toward the past, the other toward the future. We insist on the unity of time, to show that there are not three different kinds of time, one eternally dead, the second eternally dying, the third one forever and aye still-born. The past is the factor, the future the product, and the two touch in the present when the factor determines the product. The present in its connection with past and future is time, and time is eternal.

Among the best contemplations on time and space are Schiller's verses:

TIME.

"Threefold is the march of Time:
While the future slow advances,
Like a dart the present glances,
Changeless stands the past sublime.

(*Time as Future.*)
"No impatience e'er can speed him
On his course if he delay.

(*Time as Present.*)
"No alarm, no doubts impede him
If he keep his onward way.

(*Time as Past.*)
"No remorse, no incantations
Alter aught in his fixations.

(*Application.*)
"Wouldst thou wisely, and with pleasure,
Pass the days of life's short measure,
From the slow one counsel take,
But a tool of him ne'er make;
Ne'er as friend the swift one know,
Nor the constant one as foe!"

SPACE.

"Threefold is the form of Space:
Length, with ever restless motion;
Seeks eternity's wide ocean;
Breadth with boundless sway extends;
Depth to unknown realms descends.

(*Application.*)
"All three types to thee are given:
Thou must onward strive for heaven,

Never still or weary be
Wouldst thou perfect glory see;
Far must thy researches go
Wouldst thou learn the world to know;
Thou must tempt the dark abyss
Wouldst thou life's deep meaning wis.

"Nought but firmness gains the prize,—
Nought but fulness makes us wise,—
Buried deep, truth ever lies!"
(Translation by Bowring.)

CAUSALITY.

Time and space are the ideal aspects (or to speak with Kant, they are pure forms) of the real processes which we observe in experience. The order which prevails in these processes is called causation and the law of causation is causality. The problem of the evidence for the truth and the reliability of causality was first proposed by David Hume who doubted the necessary connection between cause and effect.

Hume proceeded from the sensationalist school of England and claimed that we observed constantly repeated concatenations of cause and effect, but he denied that a succession of cause and effect, if experienced ever so often, was any proof that in the future also the same succession would take place. So he turned skeptic, but he deemed the probability of the constancy of this connection sufficient to accept a belief in causality as a working hypothesis.

It is well known that Hume's skepticism set Kant to thinking, and he discovered that the certainty of our notion of causality is of the same nature as the certainty of mathematics, which means that it is purely formal. Accordingly he considered it an *a priori* truth as much as all other purely formal theorems—arithmetic, geometry, logic and pure nature-science. Kant took an inventory of our *a priori* knowledge which he discovered to be the condi-

tions of all experience and denoted them as transcendental.[7] All the store of our transcendental knowledge constitutes the possessions of pure reason.

We have come to the conclusion that Hume's conception of causality is wrong. Hume speaks of cause and effect as two "objects" that unvaryingly follow one another, and he was unable to find any reason why this should be so. We see in cause the initial start and in effect the final state of a certain event or process of transformation, and in this respect causality is identical with, or another aspect of, the law of the conservation of matter and energy. It is a purely formal statement, or to use Kant's nomenclature, an *a priori* doctrine, just as much as any arithmetical or geometrical statement, or as the logical principle, A = A.

The law of causation means that the sum total of existence remains the same. The sum total of energy and substance[8] of yesterday is the same as it is to-day and will be to-morrow. In other words, all changes that take place are due to motions, and every special case of causation which we investigate is contained within a certain field of observation; it is a mere change of form, a change of position, of configuration, of combination, of interrelation. There is first the initiative motion which enters as a disturbing factor and upsets the state of affairs in a given

[7] Kant's term "transcendental" has been the source of much confusion. By "transcendent" Kant understands what transcends our comprehension, what lies beyond it, in a word "the unknowable." Transcendental, however, is that which transcends experience as its condition. Pure logic is transcendental, mathematics is transcendental, space and time are transcendental. Logic is the condition of thought, and our notions of space and time are a transcendental esthetics—viz., the conditions of our senses, of our viewing things as objects in space and time. In Kant's phraseology, time and space are the forms of our *Anschauung*. (See on *Anschauung* the writer's *Kant and Spencer*, pp. 75-80). Things-in-themselves are according to Kant transcendent, but the purely formal sciences are transcendental. A belief in the transcendent is mysticism; but the realm of the transcendental is the arsenal of science; the transcendental furnishes us the methods of clear thought.

[8] We say "substance," not "matter," on purpose, for it is quite probable that matter is a form of ether, having originated as mass through the ether's resistance to energy.

system, viz., in our field of observation. We call it cause, and we trace the successive transpositions of parts, of the several portions of the system, until a relative rest is regained; and this new state of affairs, the final outcome of this transformation, is called its effect or the result.

Causation accordingly is a law of motion and every process of causation is necessarily mechanical. If all details were known, we could see in every single case how one change of place upsets the equilibrium of a state of things and leads to other changes of place. A cause which is not mechanical does not exist.

The reason why a cause may or must be efficient need not be mechanical, it is always a matter of form, viz., of arrangement, of configuration, of disposition, of structure. The cause itself produces its effect according to the laws of motion, but different arrangements, like different positions of a railway switch, impart to a motion different directions, and since different configurations in the domain of cerebral activity are ensouled with different meanings, the non-mechanical enters as an important factor in the world of mechanical events.

We have explained again and again the processes of causality as a transformation, yet the old traditional errors die hard and are still adhered to even by our friends who ought to be familiar with our work. Prof. William Benjamin Smith of Tulane University still continues to speak with Hume of cause and effect as "following each other"; yea he out-Humes Hume by declaring[9] that "they do not touch hands." If he had understood our view of causation he would know that they *do* touch hands, for they are not two things following each other, but the two together constitute one indivisible process and are two features of it,

[9] See Professor Smith's article "Push? or Pull?" in *The Monist* for January, 1913, p. 22.

the cause being the initiative motion, the effect the final state of one and the same process of transformation.

Hume speaks of cause and effect as two "objects following each other" and he finds that they have nothing to do with each other. He speaks of "strychnine" as "a cause" and "the dead mouse" as the result, and then he wonders what these two heterogeneous objects—strychnine and a dead mouse—have to do with each other. Naturally he is puzzled and grows skeptical. Had Hume contemplated the whole event as one process of which the cause would not be strychnine, but the eating of the strychnine, he would have seen how this initiative incident of transporting the strychnine into the stomach, affects the intestines and must result in the death of the mouse. If he had thus treated his problem he could not have doubted the connection between cause and effect. But he singles out two objects which are connected, the one with the cause, the other with the effect, and is puzzled.

What grievous mistakes such an unusually keen thinker can make! He shows his acumen by finding the problem and stating it, but in the attempt at solving it he fails most lamentably. Kant caught the right scent, he recognized the character of causality and classified it correctly with other purely formal notions. He diagnosed the case, but he failed to explain Hume's trouble. He proved that sensationalism was untenable, but did not cure the disease of skepticism, and he tinged philosophy with idealism by tracing the idea of causation back to the constitution of the human mind without investigating the origin and development of mind.

We see in causality a law of transformation, and we understand thereby not only the reliability but also the intelligibility of a necessary connection between cause and effect. We understand it to be based on the law of identity, and thus Kant is right to regard it as *a priori*. Noth-

ing has newly originated, neither substance nor energy; nothing has been lost. All we observe is a change of form, and it is the business of the scientist to trace the several stages of the process and to understand how one change of form gives rise to other changes.

We insist that causality being the law of transformation must be mechanical; it traces changes of place which follow successively step by step. Every prior change of place is the cause of the following one in a continuous concatenation; and the explanation is complete if we know in every detail how matter moves in space.

A general description of the essential features which make a cause effective is called the "reason," and the reason which is an answer to the question why certain results are produced is commonly called a law of nature. Reasons may refer to conditions which are not mechanical, but, for all that, causes remain motions, and while reasons may be logical, or geometrical or draw upon other non-mechanical domains to explain the efficiency of causes, the latter will remain mechanical.

A cause is always an event. It is a motion, a definite occurrence that takes place in a definite spot of space and at a definite moment of time; and it is a grave mistake to say with Hume that the cause is an object. Strychnine is not a cause. The eating of strychnine is a cause while its destructiveness of living tissue in any stomach is the reason of the effectiveness of the cause. The bullet is not the cause of a man's death, as Hume has it, but the vehement entrance of the bullet into his body is the cause of a laceration of his vital organs which results in death.

The whole process of causation is always mechanical and takes place according to mechanistic principle, because every transformation means change of place (motion) and a rearrangement of parts. This general law holds good for the simplest purely physical process as well as for the trans-

formations in the brain of a thinking man. There is no other way of thinking out clearly the meaning of causation.

Kirchhoff established a new conception of mechanics in his famous dictum that mechanics *describes* motions in the simplest and most exhaustive way, and it is noteworthy that he omitted in his definition the traditional term "cause." He no longer says that mechanics searches for the cause of the motions, but he simply says it "describes the motions." This strange procedure of Kirchhoff is obviously due to the metaphysical and erroneous conception which obtained in his days of the term "cause."

There has been much talk about different kinds of causes, as efficient causes, final causes, ultimate causes and a first cause, the latter having been identified with God as the cause of himself (*causa sui*); but this conception of the word "cause" rests simply on a confusion of "cause" with "reason." While causes are the incipient motions in a process of transformation, reasons are the general formulas which describe how certain causes take effect. Reasons may be more or less general, and we may consider a universal statement as the ultimate reason of a certain set of happenings. Causes are always concrete and definite; reasons are always abstract and general; causes are always mechanical in their actions, reasons are always argumentative or logical or explanatory.

The confusion between cause and reason has given rise to many errors in the domain of philosophy, and sometimes also in the heads of scientists. One of the worst errors is the belief in mysterious metaphysical causes which are assumed to live behind natural phenomena and account for them like the laws of nature with the notion lurking in the word "causes" that they, these metaphysical causes, are mysterious entities which have an existence outside and beyond the actual world in mystic domains as a transcendent extra- or super-natural essence. Kirchhoff misunder-

stood the term "cause" in this sense and so he denied the existence of causes.

If we properly understand the law of causality to be a law of transformation ultimately based on the theory that no change is due to the sudden appearance or disappearance of anything real, be it matter or energy, but that all processes are mere changes or transpositions of parts, and that new creations arise by a combination of particles in new forms, we shall see that the law of causation is a mere corollary to the mechanistic principle, and thus causality is in Kant's terminology an *a priori* truth corresponding to the logical law of identity. It means that nothing comes from nothing, and no reality, neither matter nor energy, can disappear into nothing. All that happens is transformation and is due to change of place.

It is obvious on the basis of this consideration that every portion of the causal nexus of events must be mechanical, which means that the mechanistic principle applies without any exception to all causes, and nothing is actual unless it is matter moving in space.

If this is generally true we must assume for instance that chemical processes must be regarded as due to molecular mechanics. On the other hand we know that reasons are general formulas; that they are ideas, not changes of place; that they are notions, not motions; and we must grant that the logical factors of our thought are neither matter nor energy and, as thoughts, have nothing to do with motions; nor can their explanations be derived from the mechanistic principle. How could we prove from mechanics the mortality of Cæsar which logic derives from the two premises, first from the universal law that all men are mortal, and secondly from the particular statement that Cæsar is a man? We prove logical statements by logical syllogisms.

THE SIGNIFICANCE OF FORM.

How then does the non-mechanical of the subjective domain of existence, our thoughts and ideas, enter into the mechanical world of objective reality, and how does the subjective aspect of organized beings influence the causal nexus of life? The fact is obvious that this is done, for our very existence as purposive rational creatures proves it, and the influence of the subject on the object is exerted in the same way as the subjective factors rise from merely potential existence into actual being.

Mentality originates by the representativeness of feelings. Symbols are the conveyers of meaning, and meaning is the quintessence of spirit. Where there are symbols there is spirit, and symbols possess definite forms; forms however are common to both spheres of existence, the subjective and the objective realms, for definite kinds of feeling correspond to definite forms of activity or of bodily appearance. In order to communicate a meaning we can do it only by a communication of symbols, by acoustic symbols or words, by written characters or letters, by dots and dashes in telegrams. But without symbols there is neither spirit nor the communication of meaning. The printing of a book or the writing of a letter will illustrate the important truth of the spirituality of the symbol and the non-materiality of spirit. The meaning conveyed in words, spoken or written, must find expression in objective symbols of a definite form, in air waves or in inky figures, but the meaning is neither the energy of the air waves, nor the ink of the written character. The meaning is qualitative, not quantitative; it depends upon the form of the characters used, not on the amount of energy or matter needed to produce the symbol, and form plays an important part in mechanics.

Difference of form means a difference in the factors

that guide a discharge of energy; the relationship of things imparts direction. The energy of steam in a boiler makes the engine go, but the position of the switch determines its direction. Our thoughts are sentient symbols which reside in definite forms of our brain structures, and these brain structures are efficient and transfer their activity according to their forms and the established associations in the nervous system. They determine our actions just as the cogs and levers of a machine will work in one or another way according to their construction, i. e., according to the form in which they are made and the relative positions in which they have been set.

Apparently form is the essential thing everywhere. Matter and energy are merely the material of which the cosmos is built, but the cosmos itself, its orderly realization, is in its form; the forms of existence make it what it is. Matter only renders things real, energy makes them actual, but form constitutes the essential feature of existence and contains its character. The possibilities of formation are inexhaustible; they are infinite, and for them there is no limit of perfection. All things are forms produced from the same aboriginal material; we ourselves are forms, and the form of our subjective nature, of our souls, possesses meaning. This meaning of our soul-forms is thought, it is mind, it is spirit.

At the start of the world-process the purely physical qualities of existence alone manifest themselves, but in the course of evolution life, sentiency, and thought develop, and every step forward is taken according to mechanical law. Such steps are: the origin of organized life as metabolism; the process of the preservation of form in the flux of organized life which is the base of memory; the origin of feeling by an organization of subjective states which is accomplished by the growth of a nervous system so as to enable an isolated feeling to come in contact with other

feelings, whereby feelings become conscious; the origin of mind which takes place when feelings acquire meaning; the classification of sense-impressions according to their physiological forms whereby automatically a logical system of genera and species is built up; also the development of language as the vehicle of abstract thought. Every one of these several phases in the development of the human mind is strictly mechanical; every one of them has originated in a mechanical way and finds an explanation of its mode of functioning in the basis of the mechanical principle.[10]

THE SELF-REALIZATION OF POTENTIALITIES.

There have been thinkers who on the ground of the mechanistic principle assume that the world must have some originator, a first mover, who is responsible for all the motions that take place, and especially for all that is good and noble in the world. His mental forethought must have determined the procreation of the world in all its details and especially in its final outcome or in the climax of its evolution, and the argument of this view is commonly and popularly formulated in the saying that the stream can not rise higher than its source.

This popular statement would make it quite plausible that in the evolution of life, the highest must be at the beginning, and the height of the beginning can never be reached during the process of life's history. But this need not be so; in fact it is not so. While nothing new can be created so far as substance and energy are concerned, there is decidedly a creation of new forms. The combinations that are possible contain not merely additions of parts, by external associations, but we meet also with fusions resulting in absolutely new things, possessed of new quali-

[10] Compare for a brief synopsis of these problems the author's pamphlet *The Philosophy of Form.*

ties, and this is an important truth which is frequently overlooked.

While the stream can never rise higher than its source it increases in size and in the capacity of being useful, and the lower it goes, the larger it grows. The source could not carry the pageantries of the world which the river accommodates in the harbor where its waters empty into the ocean.

It is not true that the primitive substance, the aboriginal world-stuff, must contain the seeds of all the possible creatures or things which come about by combination. A steam engine does not lie hidden in the iron of which it is constructed, nor is an organism contained in the molecules which constitute its parts. New combinations will produce new qualities which are absolutely absent in their component parts.

This is true not only in physics but also and primarily in the realm of pure thought. Kant investigated the problem of *a priori* synthesis. He asked whether or not *a priori* synthetic judgments are possible and he showed that the simplest arithmetical addition is of a synthetic nature, as for instance the statement $5 + 8 = 13$. The nature of the number 13 is not contained either in 5 or 8 but is something new, and the same is true of all the results in the domain of any of the purely formal sciences.

We do not evaluate mathematics from a mysterious geometry in and by itself, but we construct mathematics with the help of the elementary mathematical notions. When we make two lines cross each other in a plane, we produce an angle; and an angle is radically different from a line, being the inclination between the dierctions of two straight lines which is not contained in, and can not be explained from, the definition of the nature of straight lines. The same is true of triangles. The nature of a triangle has no more been deduced from straight lines

than has any other figure of geometry. We build up absolutely new and more and more complicated notions by making new combinations.

The same is true in objective reality, as for instance in chemistry. The chemist distinguishes carefully between chemical combinations and chemical mixtures. In a chemical combination different kinds of atoms are so fused together as to produce a new unity with new qualities. And with every advance of evolution new phenomena are created.

Some of the life processes can definitely be proved to be the same as other mechanical or purely physical or chemical processes, but we can not for that reason concede that life is throughout merely chemical or explicable by molar mechanics alone. Bio-chemistry has made great strides, but it will never be able to break down the barrier between chemistry and biology. There are certain features in the biological processes which are typically biological and can not be discovered in the realm of inorganic chemistry. Such processes are, for instance, the circuit of life known as metabolism, and in this constant flux the preservation of life-forms which furnishes the condition of memory, and assures the possibility of self-preservation (which is a preservation of form in the flux of metabolism) against the leveling influence of the surroundings.

There are everywhere phases of transition, but sometimes a slight modification creates the rise of a new kind of phenomena which as soon as perfected after a long preparation will show a great contrast to all other occurrences. Such a contrast originates in the appearance of animal life.

The gap between life and inanimate nature is even more marked than the gap between molar mechanics and chemistry, for in animal life we reach a new stage which displays the wonderful phenomena of sentiency. All the

processes in the domain of life are and must remain ultimately mechanical, but their mechanical nature is so complicated, much more complicated than the molecular mechanics of chemistry, and presupposes such new combinations that the life processes possess a character of their own. Under these circumstances we are justified in distinguishing between the various classes of phenomena and assigning to the different sciences domains of their own. There are other features present in vital phenomena which are absolutely absent in purely physical events, and among these features there is in animal life the appearance of consciousness and with it the rise of the will which means purposive motions. This feature increases with the progress of evolution and becomes so obvious that it may be considered as the characteristic quality of soul-life. A denial of it will prove vain, for the fact remains; and since the pursuit of purpose is so prominent in animal life, we may describe man, who has climbed to the top of self-consciousness, as the climax of purpose-pursuing animalhood.

The potentialities of existence, all the possible combinations of things or creatures which may or will originate in the course of evolution, exist in a latent state in the domain of pure form. They are mere applications of the eternal laws, so called, of the factors which direct evolution and constitute the world order, the divine dispensation which shapes the *telos* of the world, its aim and end. They are what Goethe[11] in reference to a passage in Plutarch[12] calls the mothers whose habitat is in the field of truth, a place not to be found in space, who move in a time which is above the distinction of past present and future, and breathe the air of eternity. These mothers are like the Platonic ideas and the matrices of Paracelsus.

[11] In *Faust*, Part II, Act I, Scene 5.

[12] *De defectione oraculorum*, 22.

The potentialities of existence unfold themselves according to the eternal laws of the cosmic order from the latency of non-existence into the actual life of self-realization.

The development of the world, with all the life it brings forth and the moral aspirations of rational beings, rising from the mere potentiality of existence into the nobility of a purposive thoughtful man, may be called the self-realization of God, of that eternal norm which dominates all that is, that ever has been and ever will be, of that which in its potentialities is infinite and inexhaustible. This norm is not material; it is purely formal. Nor is it an enormous amount of energy. Neither is it subjective or sentient; it is not a mysterious ego-consciousness; it is the formative principle of anything that might arise into existence; it is the potentiality of being, its law and the guidance of its formation. This norm is the eternal in the transient, it is the divinity of creation and the supernatural of nature. It is the factor that determines all things and it is He in whom we all live and move and have our being.

THE DIGNITY OF MAN.

There is no reason to decry the nature of man's mind as something low by pointing out that like a machine it works in a purely mechanical way. It is true that in this sense man is a machine, of course a living machine, but it is not true that his dignity is any way impaired by this truth, and this is an important point which ought to be discussed.

Man's dignity is not a question of fact nor of theory but merely of attitude, and yet it is for many reasons of great significance. This point, the dignity of man, implying also his responsibility for the actions he performs, is commonly treated as a side issue of the problem of the freedom of the will.

As we understand the situation we see nothing amiss in the truth that all happenings in the world, including the actions of man, take place according to the law of causation which is and must ultimately be mechanical. The intrinsic necessity with which all events take place does not mean a tyranny of some mysterious power called natural law. Necessity does not mean compulsion, and natural laws are not police regulations nor the ukases of a Czar; they are formulas summing up the essential features of processes; they are descriptions of what things or creatures will do according to their natures. The law of gravitation is not a force which drives the falling stone toward the center of the earth; it is a generalized statement of what masses will do and how they behave under given circumstances. And in the same way there are laws of a dynamics of the human will, according to which we can foresee and foretell how people of a certain character will act. An honest and noble man will in his pride and self-esteem prefer to drink the cup of hemlock rather than to slink out of the prison or cringe before his infamous judges with cries for mercy; and a villain will not shrink from theft or corruption or crime, but will be bold in action; he will not hesitate to be unscrupulous in his self-assertion.

Freedom of the will has often been doubted, but if there is no free will there is no will whatever. Every will is free, if it be will at all. Will ceases to be will if it is suppressed. Will that is not free can not act in accordance with the character of the willing person. Free will is synonymous with will.

Freedom of will means that people act, not arbitrarily, but according to their own nature without compulsion. If we know the nature of a person we can predict what he will inevitably and necessarily do under given circumstances, and prediction does not imply a suppression of

liberty. On the other hand the necessity with which free people act according to their nature does not mean that their will is unfree or that they are slaves—slaves of their own nature, subjects of their own will.

In Mark Twain's exposition,[13] the weakness of this theory that the will is not free comes out very plainly. Mark Twain claims that every man has in him a stern judge whose approval must be won, a tyrant and master who must be obeyed. We are our master's slaves. But who is this inexorable tyrant? It is our ego, it is the exponent of our personality; it is that which says in us *I*, it is the brain structure which pronounces a decision of our will, the final result of a deliberation of our wishes and fears and considerations. In a word this tyrant is we ourselves.

It is true enough that we can not help being what we are. A diamond is a diamond while grains of sand are common things, and they are what they are because the history of their origin and the circumstances under which they were formed made them so. A man is noble or vulgar because he has developed in this or that way. Nothing is what it is on its own account, or can claim any merit of its own. Nevertheless we esteem a diamond more highly than quartz crystals and we appreciate good qualities of human character. Our appreciation, however, should not exclude the recognition of the divine beauty that lives in the most common things in the snow crystals no less than in diamonds.

In all of us the cosmos lives. Everything has shaped itself in the mighty forge of existence, but there are different forms and they are by no means of equal value. Our past dwells in us as a living presence; it has made us what we are to-day, and quickens us in our actions. We are what we are because this is what under former

[13] See the article on "Mark Twain's Philosophy" in the present number of *The Monist*.

conditions we wanted to be. Our past actions, our former doings, have shaped our character as it is now.

Man possesses a dignity peculiar to himself. It consists in having reached a comprehension of himself. He has learned to judge his own will, he can approve his volitions, he can condemn them and he can form ideals. He can form a conception of what he wishes to be and this conception of his ideal self becomes a factor in his life. He can grow beyond his present self, he can improve. Rückert, one of the most thoughtful German poets, says:[14]

> "The type he ought to be
> Each one bears in his mind.
> Until that be attained
> He never peace will find."—Tr. by P. C.

Man establishes principles of action, to will or not to will this or that. According to conditions he either follows his principles or is remiss in his obedience to them, but in every case his own will plays a significant part in the development of his character, and it is therefore quite justifiable to hold him responsible for his actions. The feeling of responsibility and our neighbor's opinion of our responsibility are factors in our lives which strengthen our good intentions, while the idea of irresponsibility acts like a bane that paralyzes the will.

A man is not responsible for his actions only if he acts under compulsion against his own will, if he is intimidated by some external power, either by direct violence or a threat—in brief, if he is not free. In such a case his actions are not a genuine expression of his character.

We must remember that there is a difference between necessity or determinedness on the one hand and compulsion on the other. Everything is determined, even the decision of a free will. The will of a free man is determined by the man's character. There is no sense in defining a

[14] See the author's little book *Personality*, p. 7.

free will as undetermined or undeterminable or arbitrary. An arbitrary will would be the outcome of chance and as such it could have no moral value, no dignity, and would not convey any responsibility.

MAN'S DIVINITY.

Having come to the conclusion that man is a machine, Mark Twain was overcome by a great desolation because he saw the dignity of man dwindle away under the thought that man possesses no merit whatsoever. But what ground is there for dejection if man's actions really take place in accord with the mechanistic principle? Is man the worse that he is no exception to the common natural law, that his activity, like any other event in human nature, is subject to the law of causation? Even though the means by which nature, with the help of mechanical laws, attains her end to produce a rational creature be very simple, the fact of man's high standing in nature remains the same.

Here is the point which is of great importance, and which we wish to bring out. Man's divinity is not less divine because he has developed in perfect accord with the laws of nature; on the contrary, this very feature constitutes his divinity.

We understand by God "the authority of conduct" and the ultimate standard of goodness in the constitution of the universe. He who lives in agreement with the cosmic order is moral, he who infringes on it becomes alienated from the divinity of existence, and we must bear in mind that the laws of nature are ultimately mechanical. The laws of chemistry, of molecular mechanics and all other laws that regulate the order of events are simply applications in specially complicated fields. The simplest laws are not superseded in the more complicated conditions but expanded and specialized. The laws of social interrelations, of historic movements, of progress and evolution are not excepted,

and we do not hesitate to say that the multiplication table has more to do with justice and righteousness than a belief in special revelations or in mystical dogmas.

There is something holy about arithmetic and mechanics which would do us all good to appreciate. Any one who ventures into an investigation of mechanical laws will come to the conclusion that they present a grandeur of nature which is truly divine, a grandeur which shows a wondrous consistency and reliability, which always remains faithful to itself, which brooks no exceptions, and lies at the bottom of the grand cosmic order, so mysterious in its results and yet ultimately so simple. All the different happenings in the world are applications of the same universal principle, and all the differences of the various laws of nature are ultimately one and the same truth differently applied.

If we were omniscient we could trace the same mechanicalism everywhere in all happenings. We would be able to derive every special truth from the universal law of transformation by mechanical changes and predict what will happen under given circumstances even where we can have no personal or direct experience. The laws of mechanics give us a key to the riddles of all the events that happen in the universe, of the motions of atoms as well as the whirls of the galaxies of whole Milky Ways.

What is there mean or low in the domain of mechanics? How can we look down upon the harmonious order of all the moving bodies so as to make us feel ashamed of our own existence for partaking of this same disposition?

The dignity of man justifies us in speaking of the divinity of the cosmic constitution; and the grandeur of the cosmos justifies our belief in the dignity of man, for man is the highest creature of creation and in him we see the cosmic order reflected—or to use the language of religion, man is an incarnation of God.

Whether or not the transaction of the human will can be explained from mechanistic principles, the dignity of man remains the same, and as soon as we grant that man's appearance on earth is not due to an accident but to the proper working of natural laws, we grant that the rationality of man, which conditions his ability to adapt himself to the future, to direct his affairs, and to pursue plans, is a feature that has its counterpart in the cosmic order of natural laws, and the cosmic order is intrinsically characteristic of the constitution of the universe. All existence is dominated by laws, or better, it exhibits uniformities that render such an outcome, the procreation of rational beings, not only possible but necessary, and we can trace the progress of anthropogenesis step by step as produced by mechanical law.

What can there be unworthy in this truth?

THE UNIVERSAL AND THE PARTICULAR.

What surprises us mainly when we consider the worth of human personality is the particular, the peculiar, the individual character of every single man.

On the one hand we insist that all men are brothers, that we must respect in every individual person his humanity, those features which all men have in common, consisting in human rationality and the humaneness shown in their superior morality which raises them above the level of the beast. On the other hand we notice that no two persons are alike. Every one works out an idiosyncrasy of his own, and while we respect the general feature, the humanity of man, as the basis on which we recognize him as a brother, we appreciate at the same time that particularity which constitutes his individual character, his unique selfhood, his particular personality.

A herd of sheep is to us a number of pieces of living things—of wool and mutton. We do not care for the in-

dividualities of the different sheep. We ignore their particular traits except in so far as they have a bearing on their marketable qualities, the tenderness of mutton or the softness of their wool. They are to us mere numbers of equivalent units that can be expressed in pounds, and on account of our indifference most of us are unable to tell them apart. One sheep is to us like the other, but in reality they are individuals and are by no means absolutely like one another; for all things in this world possess individualities of their own, even though we are ignorant of the differences and may not be able to appreciate their variations.

It is remarkable that snow crystals have been photographed in large numbers, and yet there have not as yet been found two crystals which are alike. Every one possesses its own individuality, and we may add, a soul of its own.

The general law according to which snow crystals form is universal. The law is the same under any and all conditions. Everywhere we observe the hexagonal type which makes the crystal grow at angles of 60°, but while the law is general the variety of conditions must be so infinitely illimitable that every single speck of vapor forms a crystal of its own making, which however to a gross observation will seem like all the rest on account of our indifference to their varieties.

It seems to us probable that the same will be found true in all things. If we could see before us the atoms of gold we might not be able to find two atoms which are exactly alike, while all of them would be expressions of the same general law. And further what is true of the smallest particles of existence will probably be true of larger aggregates such as solar systems and planets. If we could search the heavens we would find it difficult to find two planets which would show the same conditions in their general

formation, and probably also in the development of life on their surfaces, and yet all of them would be subject to the same law, and all of them accordingly would have some characteristics in common with the rest.

The universe seems to be a world of universal law, and at the same time of a particular individuality of detail, and it appears that the wonder of this world of ours is the infinite variety of forms in spite of the rigorous uniformity which we call law. There is a universal order and yet a liberty of individual self-formation.

Mathematical space is the same all through and yet every point in it has its own special place. Why should not every speck of existence in the real world possess its own particular quality?

THE DIVINITY OF THE MECHANICAL LAW.

We stand midway between the two parties, between the mechanistic scientist and the teleological thinker. We recognize rigorously the mechanistic principle as applicable to all motion, but for that reason we do not deny that there is purpose in the world. Purposive creatures develop with mechanical necessity and their appearance in the cosmic process is significant. We even grant that the development of the world has a definite direction, a *telos* or aim, but we can no longer conceive of this aim as the design of a demiurge, of a world-builder, who after the fashion of a man has constructed the mechanism of the universe as a watchmaker makes a watch, and lets it run in a mechanical way, now and then interfering with the mechanism by what mortals call miracles. The direction of the evolution of worlds, of planetary systems and of the development of life on the several planets, is not a contrivance of an all-wise creator, but is determined intrinsically by the divinely grand immanent order of consistency, which is the foundation of all the uniformities of natural phenomena.

Our aim is to establish a rigidly scientific philosophy. We recognize only those truths which can stand the test of scientific critique. Nevertheless our philosophy is not anti-religious as science need not be anti-religious. We are conservative, for we see in religion a phenomenon that develops as naturally and necessarily as human society, the state and other institutions.

The several religions, foremost among them Christianity, are instinctive attempts to attain the truth needed for practical life. It is natural that such truths have been formulated in mythological tales and in allegorical dogmas, and it is but fair to judge dogmas and myths according to their meaning. Belief in the letter killeth, and the truth of religion consists in the spirit of its doctrines.

Not the least valuable doctrine of Christianity is the idea of God, but even here we are confronted with an allegory. The highest efflorescence in the universe is man and so it is quite appropriate to represent God, the All-being, the highest and absolute authority to which we must conform, under the simile of a human personality, as a king or a father. This has been done in Greece where the Homeric heroes begin their prayer "*Zeu Pater*"; in Rome were Jupiter, i. e., Jove the father, is worshiped; in ancient Persia, in Judea, in Christianity, in China (where God is called *Shang Ti* = the emperor on high) and elsewhere. But this God-conception must not be taken literally, for God is not and cannot be an individual personality; God is super-personal. He is not a person in the sense of a concrete human personality, with human limitations in space and time, with successive thoughts, deliberations and final decisions. His thoughts are the eternal norms of existence, called laws of nature by scientists, and wherever there is a truth that has never originated and will never pass away it is a thought of God, for God is the ultimate

norm of truth, the ultimate standard of goodness, the prototype of right, the authority of moral conduct.

If God were an individual being, there would be above him the divinity of the eternal norm of all order. A divine individual, were he ever so grand, would be *a* god, not God, and if we call a god-individual "God" there would be a higher authority above God, there would be the Over-god, whose norms this individual god-being would have to heed, a view which would lead us to fantastic and mythological ideas. Accordingly it will be soberer and truer to reserve the name God for that absolute Divinity who is the normative factor that shapes the world and who at the same time remains to all his creatures the ultimate authority of moral conduct.

The world with all its wonderful display of life is the result of the cosmic order. There is an eternal law that shapes its *telos,* its aim and end. It is the divine dispensation according to which from the very beginning the springs which prompt existence unfold themselves and manifest their inmost meaning. Thus existence tends with mechanical necessity to realize itself, and in doing so it manifests the divinity of the world order whose most general features are mechanical.

The intrinsic nature of the world order is best understood by a contemplation of the order that prevails in all the purely formal sciences, in mathematics and logic, in arithmetic and algebra, which is most obvious and presents itself visibly to the eye in geometry. If there is anything that deserves the name supernatural we must grant this term to these purely formal sciences or rather to the truths which they reveal. They hold good not only in nature as it presents itself to our experience, not only in this world of ours in which we live, but in all possible worlds which might exist anywhere or anywhen, and they will remain true even if nothing existed at all.

The direction of all motion of the world is not artificially imposed upon it from the outside, it is immanent; and the appearance of rational purpose-ensouled beings is a necessity in the development of life, because the cosmic order renders the growth of rationality necessary. Rationality as a matter of truth, is nothing but the recognition of the cosmic order and the practical application of this recognition, the recognition of the cosmic order, of the nature of causation, of the mechanistic principle, changes wild haphazard motions into the provident actions of a purposive will.

We reach the conclusion that a belief in the divinity of man, in his responsibility and in his freedom, is quite justified, even on the recognition of the mechanistic principle, and that the popular errors held about these ideas on either side, from the teleological and from the mechanistic standpoints, are mistakes which by no means touch the essential truths which obtain in both.

A deeper investigation into the constitution of existence and the significance of natural, and especially mechanical, laws proves that a scientific interpretation of the facts will by no means degrade the character of man or give us cause to embrace a dreary pessimism. The laws of mechanics are the most general laws of the universe. Nothing moves, nothing stirs nor happens that does not act in agreement with the laws of motion, and there is no harm in it that man's activity takes place in perfect agreement with mechanical laws.

A man's a man for a' that!

EDITOR.

CRITICISMS AND DISCUSSIONS.

THE NATURE AND VALIDITY OF THE PRINCIPLE OF LEAST ACTION.

This paper is critical and expository. I have already* examined, in some detail, the views of Maupertuis, Euler, d'Arcy, and others: we shall now be concerned with testing these views. The object of this testing is what I take to be the object of all historical and critical investigation in science: the elucidation of principles and methods by emphasis on what has shown itself to be psychologically important. In science and in the philosophy of science we are concerned with truths of fact, and usually only very indirectly with the people who assert or deny these truths. But, while this is our object, we know by experience that we can get a firm grasp of the truth by studying the aims, mistakes, and methods of those who have sought and found these truths. This is, perhaps, the only way of getting a firm grasp of the truths. But this is a psychological question. It is, I think, a defect in human nature that different values are placed on different truths; all truths should be of equal value. History and criticism often teach us to counteract this wrong apportionment of values by drawing our attention repeatedly to overlooked or underestimated truth. For example, the principle of least action (A) necessarily requires a certain condition which we will call B. Now B seems to require C (the conservation of *vis viva*) to hold, and C certainly implies B. But B does not imply C, though many very eminent mathematicians have thought that it does. They never explicitly formulated this opinion, or else of course they would have seen its error.[1] Now history and

* *Monist*, April and July, 1912, Vol. XXII, pp. 285-304, 414-459.

[1] I have heard of a lecturer who used to tell his pupils not to bring their difficulties to him until they could express them clearly. He might almost as well have told them always to settle their own difficulties for themselves. Often the whole difficulty of a difficulty lies in our not being able to set it down in words, because our ideas are vague or confused, often unconsciously so.

criticism lead us *to lay stress on* the facts that: (1) A implies B and B implies A; (2) C implies B, but B does not imply C; (3) C implies A, but A does not imply C. On the other hand, if we merely write the theorem in the form: C implies B, B implies A, and A implies B, we lose sight of the important fact that B does not imply C. The fact that B does not imply C might, indeed, be stated in logical terms, but, as it is what is called a "negative" proposition and gives rise to no "useful" conclusions, it is omitted from most text-books.

But our considerations are not only about text-books, which only too often succeed in making an unfortunate compromise between logic and history. We must emphasize that a perfect *logical* statement of truths is often of no more help to us than an ordinary text-book. Prolixity is an enemy to our process of understanding, but it is often necessary in logic; redundancy is never necessary in logic, but is often necessary to the correct working of our process of understanding. We know the value of judicious repetition when teaching, and historical and critical studies are concerned with the teaching of truths. Of course we are liable to fall into the error of saying, and perhaps thinking, that the truths with which it is our object to become acquainted *develop*. But it is our knowledge of them that develops. Some philosophers think it is a demerit not to develop or be in motion, and so maintain that truth grows, or is fluid. But this seems as bad as confusion of the qualities of America with those of its discoverer.

In logic we say that C implies B; we do not need to emphasize that this does not imply that B implies C; and yet the history of the principle of least action shows us how important this emphasis may be. Then again, we know how important psychologically may be the platitude that such and such a thing may or may not be so. Then too there is the fact that in a purely logical exposition the definitions, though logically irrelevant, are important.[2]

[2] A. N. Whitehead and B. Russell, *Principia Mathematica*, Vol. I, Cambridge, 1910, p. 12: "In spite of the fact that definitions are theoretically superfluous, it is nevertheless true that they often convey more important information than is contained in the propositions in which they are used. This arises from two causes. First, a definition usually implies that the *definiens* is worthy of careful consideration. Hence the collection of definitions embodies our choice of subjects and our judgment as to what is most important. Secondly, when what is defined is (as often occurs) something already familiar, such as cardinal or ordinal numbers, the definition contains an analysis of a common idea, and may therefore express a notable advance. Cantor's definition of the continuum illustrates this: his definition amounts to the statement that what he is defining is the object which has the properties commonly associated with the word 'continuum,' though what precisely constitutes these properties had

We have already considered the historical question relating to the principle of least action, and may now—with some relief, considering the not wholly pleasant side of human nature which we have had to take into account—leave history and confine our attention to criticism. We shall examine into the validity of the various views we have described with some minuteness, making use, where necessary, of the results of modern investigations on the principles of least action and allied principles. At the close, I trust that we shall have attained to a quite satisfactory conception of the principles in question, for a historical and critical research seems to me to present special advantages. In the first place, we see in work actual methods of investigation, and these examples are valuable guides, both in showing us the best sort of thing to do and what sort of thing to avoid; and, in the second place, we are, I repeat, led to emphasize the psychologically important points in a principle or theorem. In a theorem written out in a perfect logical form, a hypothesis on which it may be important psychologically to lay stress is not particularly marked off from the others, and a hypothesis which is not made, and which it is important to mention as not having been made, is simply unmentioned.

In the present article I will first of all give some considerations on the differential equations of mechanics, which will enable us to determine the nature of the principle of least action and fix its position with respect to other principles such as that of d'Arcy. Then we come to the far harder question as to the extent of the validity of the principle, but this has, I think, been answered quite satisfactorily in modern times, principally owing to the work of Hölder. I have previously dealt with this matter.

The second part (section IV) of the present article will, then, be devoted to an examination of the assertions made about and problems alleged to be solved by, the principle of least action.

I.

The differential equations of mechanics are *ordinary* equations of the *second order*; that is to say, there is only one independent variable—not many, as in the theory of the conduction of heat[3]—

not before been known. In such cases, a definition is a 'making definite': it gives definiteness to an idea which had previously been more or less vague." In 1894 Peano (*Notations de logique mathématique*, Turin, 1894, p. 49) said: "The utility of definitions is well known. But we must remark that, rigorously speaking, they are not necessary."

[3] Cf. Mach, *Die Principien der Wärmelehre*, 2d ed., Leipsic, 1900, pp. 82-100.

and the order of the highest differential quotients occurring in them is the second. The dynamical equations are of a simple form that offers special facilities for integration;[4] but even now these equations cannot be integrated generally. The typical form of such equations is, to begin with, the simple case of one particle of mass m acted upon by what is known as a "conservative" system of forces,

$$m(d^2x/dt^2) = X,$$

where X is a function of the coordinates (x, y, z) of the particle, and not of t.[5] There are three such equations (for the three coordinates) for each such particle m, and the other two are:

$$m(d^2y/dt^2) = Y, \quad m(d^2z/dt^2) = Z.$$

For a swarm of n such particles we have $3n$ equations. Here come in mutual attractions and so on, that we will consider below.

Of course such "particles"—mathematical points endowed with mass—are mathematical fictions, and only a first approximation to reality. But, building on such foundations, we reach, as Newton did and as students of the theory of attractions know well, a theorem according to which nothing is altered—possible impacts apart—if the particles are replaced by homogeneous spheres of matter. This gives a second, and much closer, approximation to the actual state of things in the solar system. This example, by the way, is typical of the manner in which we always proceed in mathematical physics. By successive attempts we make our mathematical model imitate actuality more and more, somewhat as a portrait-painter proceeds;

[4] Chief among the works that deal with the integration of the dynamical equations are Jacobi's lectures on dynamics (*C. G. J. Jacobi's Vorlesungen über Dynamik. Gehalten an der Universität Königsberg im Wintersemester 1842-1843 und nach einem von C. W. Borchardt ausgearbeiteten Hefte herausgegeben von A. Clebsch*, Berlin, 1866; second edition, revised by. E. Lottner, in *C. G. J. Jacobis Gesammelte Werke: Supplementband*, Berlin, 1884.)

[5] It may not be amiss to mention here a difficulty with regard to the meaning of the dynamical equations which often puzzles students and, I regret to say, teachers too. It is this: "If $m.d^2x/dt^2$ is the force on the particle m, and X is also this force, what is the above equation but an identity? And is it maintained that an identity of the form $X = X$ is the fundamental principle of dynamics? The answer is that whereas (supposing, for brevity, that we have only one coordinate, x, to deal with) X is a known function of the unknown x, x is an unknown function of the unknown t. The above equation then asks the question: What function of t must x be in order that $m.d^2x/dt^2$ is identical with X? When this question is answered (when, as we say, the equation is "solved"), the only unknown remaining is t. That is to say, the function that x is of t is determined for a whole class (usually infinite) of values of t. This is what is meant by calling t a "variable." Of course, t and x and so on denote (ambiguously) the numbers which are the measures of the times, spaces, and so on, considered, and not these physical objects themselves. Yet, for the sake of shortness, I will say "v is the velocity" for "v is the numerical measure of the velocity."

but the portrait-painter, urged by artistic feeling, sometimes modifies, emphasizes, and suppresses, while we only consciously do these things when we are occupied with the psychological business of instilling truths discovered about nature into ourselves or others.

To return to the differential equations of motion. Let us consider a very simple case. Take the general equation of rectilinear motion in dynamics:

$$(d^2s/dt^2) = f(s),$$

where s is the distance measured from a fixed center of force upon the line of motion. Introducing the abbreviation v for the velocity, the above equation turns into a pair of differential equations of the first order, for s and v:

$$(dv/dt) = f(s), \quad (ds/dt) = v.$$

Now use the infinitesimal method[6] and eliminate, by ordinary algebra, dt from this pair of equations. We get:

$$v.dv = f(s).ds,$$

which can be immediately integrated in the form:

$$\tfrac{1}{2}v = \int f(s).ds + \text{const.}$$

Then we substitute the value of v we get from this in the equations of the pair, and get s in terms of t and t in terms of s. The result of the first integration is called a "first integral" of the given equation of the second order; it contains one constant of integration, and its complete integral, which contains a second constant, is the "complete integral" of the given equation. The complete integral of an equation of the second order is a relation between the independent variable, the dependent variable (in our typical case, t and s respectively), and two arbitrary constants; and conversely, any such relation may be regarded as a primitive, from which a differential equation free from arbitrary constants can be obtained.

Let us consider how the first integral referred to gradually appeared and took its place in the history of mechanics.

Galileo considered the motion of a single body near the surface of the earth, and it was Huygens who first published an account of a mechanical problem involving many bodies. It cannot, by the way, be emphasized too strongly that it was Galileo's researches alone which were used in Newton's early work. Galileo, by his dis-

[6] On another occasion, I will discuss the legitimacy of treating, as is universally done in analytical physics, dx and dt as if they were small, finite, real numbers.

covery of the law of inertia, had destroyed the old belief that motion always requires the continual exertion of some force to keep it up. Thus, to explain the motions of the planets, was required, not the vortices of Descartes, but some force by which the planet was continually deflected from its straight and uniformly described course. Newton began by applying the dynamical principles of Galileo to astronomical events. When he came to consider the mutual actions and motions of two bodies, it is probable that, by formulating an instinctive belief of himself and others, he had attained his fundamental law before Huygens's results were printed. Newton's researches were due to three influences: first and foremost were Galileo's dynamical investigations; then there was Copernicus's (1473-1543) revival of the theory that the sun is the center of our system; and lastly there were the laws discovered by Johann Kepler (1571-1630) as a result of long study of the astronomical observations of his teacher Tycho Brahe (1546-1601) and himself.

Returning to the history of the above integral, it will be instructive to sum up what Huygens[7] did. Galileo[8] had discovered three equations holding between the time during which a body falls near the surface of the earth, the distance fallen through, and the velocity attained by the falling. One of these—the one from which Galileo set out—is

$$v = gt,$$

and in modern terminology, since $v = ds/dt$, we can get Galileo's relation between s and t by integration. From this, $s = gt^2/2$, and the first relation, we get Galileo's equation between s and v:

$$gs = v^2/2.$$

Now, this last equation is a first integral of the differential system:

$$dv/dt = g, \quad ds/dt = v,$$

for falling motion near the surface of the earth; for, if we differentiate the last equation but two, the result becomes an identity if we substitute g for dv/dt, as we are allowed to do by the given system.

If we introduce the conception of *mass*, we can put Huygens's generalization of Galileo's integral into the form:[9]

$$\Sigma ph = \tfrac{1}{2}\Sigma mv^2;$$

[7] Mach, *Mechanics*, pp. 173-180.

[8] *Ibid.*, p. 148.

[9] Mach, *Mechanics*, p. 178.

and this again, when the forces are not necessarily constant nor the paths of the masses rectilinear,[10] becomes

$$\Sigma \int p \, . \, ds = \tfrac{1}{2} \Sigma m (v^2 - v_0^2),$$

or, as it is usually written when a force-function U exists,

$$U - U_0 = T - T_0.$$

This generalization is, we can say, immediately brought about by familiarity with the infinitesimal calculus.

Now, this last equation is a first integral of the system of dynamical equations, just as, in the above case, Galileo's equation is a first integral of the system of equations of the second order which describes the motion of falling. That is to say, if we differentiate the equation between T and U, the result becomes an identity by means of the relations given by the general equations of dynamics. The integral in question subsists under certain conditions which a precise mathematical formulation reveals. We will come on this question again immediately and also farther on.

When, as in the case of the compound pendulum, there is only one degree of freedom,—that is to say, there is only one geometrical quantity or "generalized coordinate" by which the position of the system is determined,[11] which is to be found as a function of the time, —this single integral gives the complete solution of the problem, for everything then reduces to a differential equation of the first order with one independent and one dependent variable.

We have seen how a single differential equation of the second order between one independent variable (t) and one dependent variable (s) can be replaced by *two* simultaneous equations between one independent variable (t) and two dependent variables (s and v). Our system of $3n$ dynamical equations can be replaced by $6n$ equations of the first order connecting the independent variable with $6n$ dependent variables (the coordinates and the velocities).[12] This system has for its complete solution $6n$ integral equations connecting the variables and involving $6n$ constants of integration. In the case,

[10] Cf. *ibid.*, pp. 276-277, 343-344, 350.

[11] In the case of a rigid pendulum oscillating in a plane about one point, this quantity is obviously the angle a line fixed in the body and through that point makes with the vertical through that point.

[12] In the case of one or many particles, what can with advantage take the place of the X in our typical equation for *one* particle is a partial differential quotient of a certain function of the position of the system. This function (the "potential function") is a function of the coordinates of *all* the particles of the system, and is of very great importance in almost all parts of mathematical physics (cf. Mach, *Mechanics*, pp. 110, 398, 497-499).

for example, if the system of the dynamical equations we can often so combine them that an integral results. Thus in a more general case than that dealt with just above, from the system

$$m\,\frac{d^2x}{dt^2} = X, \quad m\,\frac{d^2y}{dt^2} = Y, \quad m\,\frac{d^2z}{dt^2} = Z,$$

we get, by multiplying the equations by dx, dy, and dz respectively, and adding, the equation

$$m\,\frac{dx}{dt}\,\frac{d}{dt}\,\frac{dx}{dt} + m\,\frac{dy}{dt}\,\frac{d}{dt}\,\frac{dy}{dt} + m\,\frac{dz}{dt}\,\frac{d}{dt}\,\frac{dz}{dt} = X\,dx + Y\,dy + Z\,dz.$$

Now, if a force-function U exists which is a function of x, y, z, and not t, and such that the right-hand member is its exact differential, then both sides of the above equation are obviously exact differentials. Integrating, then, we get what later writers called the equation of *vis viva*, and nowadays we call the "equation of energy." Evidently this reasoning extends to cases of more than one particle.

We can also define a "first integral" of the system of $6n$ dynamical equations in an obviously equivalent way as follows: A first integral is an equation $\phi = \text{const.}$, where ϕ is a function of the $3n$ coordinates $(x, y, \ldots)$, the $3n$ velocities $(v, w, \ldots)$, where $v = dx/dt$, $w = dy/dt, \ldots$, and the time t, such that $d\phi/dt$ vanishes identically by means of the given system. Sometimes the function ϕ itself is called the integral. An integral is given by the principle of *vis viva*, just spoken of, and other integrals are given by the principles of the conservation of the center of gravity[24] and areas.[25] Let us consider more closely the conservation of the center of gravity.

We may consider the force X on the particle m in the direction of the x-axis to be composed of two parts: one (X') due to the actions x, n of the other particles of the system, and one (X'') due to the external forces on the system. We can thus put:

$$X = X' - X'',$$

and analogously for Y, Z, and so on. Now, by Newton's third law of motion, $\Sigma X'$, where the summation indicated by the Σ extends to all the particles of the system, is zero. If also there are no external forces, each X'' is zero. Thus, adding the equations of motion, we get:

$$\Sigma m\,(d^2x/dt^2) = 0,$$

[24] Cf. Mach, Mechanics, pp. 343-350.
[25] *Ibid.*, pp. 287-293.
[26] *Ibid.*, pp. 293-305.

and two others for the y-coordinates and z-coordinates respectively. These equations can be at once integrated and give the "principle of the conservation of linear momentum" or of the conservation of the center of gravity. In fact, by one integration,

$$\Sigma m(dx/dt) = a,$$

where a is a constant. This is the theorem stated in the third Corollary to the Laws of Motion in the *Principia*. The fourth Corollary merely requires the knowledge that the coordinates of the center of gravity of the dynamical system are $\xi = \Sigma mx/\Sigma m$, and two other identities. Thus we see at once that $d\xi/dt$ is constant. The above equation expressing the conservation of momentum gives $3n$ first integrals, and $3n$ other integrals are obtained by renewed integrations. In the above typical instance, a second integration gives

$$\Sigma mx = at + b,$$

when b is a constant.

The case is not very dissimilar with the integrals expressing the conservation of "angular momentum" or of areas. In this principle we have $3n$ equations of the form

$$\Sigma m[x(d^2y/dt^2) - y(d^2x/dt^2)] = 0,$$

which give, on integration, $3n$ first integrals of the form

$$\Sigma m[x(dy/dt) - y(dx/dt)] = c,$$

where c is a constant. But—and here the principle of areas differs from the principle of the conservation of linear momentum—no further integration in finite terms is possible.

Now d'Arcy's principle is the principle of areas, while the principle of least action is a condensed form of the equations of motion. The principle of least action is more general than that of areas, but the principle of least action does not give an integral. Consequently, we cannot allow that d'Arcy's claim[16] that his principle can replace what the principle of least action meant to state and that other integrals can be deduced from it, is valid. It might just as well be maintained that the knowledge of one root of, say, a cubic equation enables another to be calculated, in general.[17] In the case of another integral of the dynamical differential equations—the integral of *vis viva* just dealt with—the analogous problem has

[16] *Monist*, Vol. XXII, pp. 446, 453.

[17] If we are given a complex root, and we know that the coefficients of the equation are real, we know that another root must be conjugate; but this is not the general case.

been, according to Boltzmann,[18] the vainly sought ideal of some of the supporters of the modern science of "energetics."

II.

We shall here make two digressions. In the first place, even when the dynamical equations are under the most favorable conditions, so that all the above integrals subsist, we cannot, in general, solve the equations completely. Consider in the general case the motion of a system of particles which act on each other according to the law of gravitation. The acceleration of any particle P is compounded of accelerations to each of the others, and any one of the components thus arising is of the form $\gamma m/r^2$, where m is the mass of one of the particles and r is its distance from P. For such a system there would exist seven first integrals, and ten integrals in all, of the equations of motion. In fact the principle of the conservation of linear momentum would give six integrals in all, representing that the center of inertia of the system moves uniformly in a straight line; the principle of the conservation of moment of momentum would give three integrals, representing that the moment of momentum of the system about any one of the axes of reference is a constant quantity; the principle of the conservation of energy would also give an integral. The general problem of two bodies was solved by Newton in the *Principia*; but even in the case of three particles these ten integrals do not suffice for the complete description, in a finite form, of the motions of the system; and in 1887 Bruns[19] showed that all the other integrals of the problem of n bodies besides these algebraic functions of the coordinates and velocities are *transcendent*. The most interesting practical result of all this is that we cannot deduce from the law of gravitation an exact account of the motions of the bodies forming the solar system. But there are a number of circumstances which conduce to the possibility of deducing from this law such an approximate account of the motions in question as shall be sufficiently exact to agree with observation

[18] "Ein Wort der Mathematik an die Energetik," *Ann. der Phys. und Chem.*, Vol. LVII, 1896, pp. 39-71; cf. especially p. 40.

[19] "Ueber die Integrale des Vielkörper-Problems," *Leipziger Berichte*, Vol. XXXIX, 1887, pp. 1-39, 55-82. In this paper, Bruns seeks the algebraic integrals which do not contain t explicitly. Bruns also wrote another paper on the same subject in *Acta Mathematica*, Vol. XI, pp. 25 ff. Cf. A. R. Forsyth, *Theory of Differential Equations*, Vol. III, Cambridge, 1900, Chap. XVII; and E. T. Whittaker, *A Treatise on the Analytical Dynamics of Particles and Rigid Bodies, with an Introduction to the Problem of Three Bodies*, Cambridge, 1904, pp. 346-367.

over a long period of time. Among these we may mention: (1) that the mass of the sun is great compared with that of the other bodies, even the mass of Jupiter being less than $\frac{1}{1000}$ part of that of the sun; (2) that all the orbits are nearly circular and lie nearly in one plane.

In the second place, it is proper to refer here to the equations of dynamics as they appear when we use the vector methods of Hamilton, Grassmann, and others.[20] Instead of $3n$ equations, we have only n equations, and this gives us some idea of the shortness with which we can write out theorems. But the most important advantage of vector methods in mechanics and physics is that all the operations correspond exactly to the fundamental operations with motions of mechanics. Velocities and forces and axes of couples are various kinds of (unlocalized or localized) vectors; addition is like the composition of velocities; Grassmann's "inner" multiplication of two vectors is what, if one of the vectors is a force and the other the velocity of its point of application, we call "the rate of working of the force"; and so on. Then, as O'Brien[21] has remarked, the use of vector methods facilitates, in certain cases, the technical process of integration. Lastly, as I have pointed out in notes to my translation of Mach's *History and Root of the Principle of the Conservation of Energy*,[22] vector methods afford a powerful and effective means of discovering, and representing in intuitive form, the ultimate principles of physics.

III.

We will now return to the equations of mechanics. Since the system of the internal forces (such forces as we have denoted above by X′) is equivalent to zero, it is convenient to be able to express the equations of motion in a form into which only the external forces (denoted by X″ above, and henceforward by X) enter. This was done by d'Alembert in 1743,[23] and a succinct expression in a variational form was given to d'Alembert's principle by Lagrange in 1788.[24] We will here merely state this formula, in which the whole of mechanics is condensed:

[20] Mach, *Mechanics*, pp. 527-528, 577-579.

[21] *Phil. Trans.*, Vol. CXLII, 1851, pp. 161-206.

[22] Chicago, Open Court Publishing Co., 1911, pp. 106, 108.

[23] Mach, *Mechanics*, pp. 331-343.

[24] This is the date of the first edition of Lagrange's *Mécanique*; but the variational form of d'Alembert's principle appeared in papers of Lagrange's dating from 1764 and 1780.

$$\Sigma[m(d^2x/dt^2)\delta x + m(d^2y/dt^2)\delta y + m(d^2z/dt^2)\delta z] = \Sigma(X.\delta x + Y.\delta y + Z.\delta z)$$

and will refer to Mach's *Mechanics*[25] for the meaning of the δx's and so on used in it. Our purpose here is merely to indicate that the principle of least action is a transformation of this variational equation.[26]

We will first remark: (1) that this single equation contains, so to speak, the whole of mechanics; and (2) that it is far more general than the system of equations already dealt with, as it holds for a system subject to any conditions, even if they depend on the time, and does not presuppose the existence of a force-function.

When we differentiate by δ the equation of *vis viva*, substitute in the above general equation of mechanics, change the order of d and δ in such terms as $d\delta x$, integrate with respect to s, and determine that the variations of the coordinates vanish at the limits of integration, we obtain the result that

$$\delta\Sigma m \int u.ds = 0,$$

where u is the velocity of the particle m and ds is an element of the path described by that particle.

That the vanishing of the variation of a function implies that this function is a maximum or a minimum was never doubted by the older analysts, including Lagrange; but Sir William Rowan Hamilton replaced the name of "the principle of least action" by the less committal name of "the principle of stationary action."[27]

Conversely, by carrying out the variations in the equation last given and eliminating the variations δu by means of the equation of *vis viva* differentiated by δ, we arrive at the equation expressing that the integral with respect to t of the function which, when equated to zero, is the variational form of d'Alembert's principle, is zero. Now, this equation must subsist for all possible variations and consequently the integrand must vanish at every moment.

Lagrange[28] remarked that the integral in the principle of least

[25] Mach, *Mechanics*, pp. 342-343, 466.

[26] Here we follow Lagrange (1788). A convenient annotated German translation of that part of Lagrange's *Mécanique* which refers to this point is given, with other matters, in No. 167 of *Ostwald's Klassiker*.

[27] The name of "principle of stationary action" is also often given to that other principle which is allied to the principle of least action, and is generally called "Hamilton's principle" (cf. for example, L. Boltzmann, *Vorlesungen über die Principe der Mechanik*, Vol. II, Leipsic, 1904, p. 9).

[28] In the second edition of his *Mécanique* (Vol. I, 1811), not in the first 38). Cf. *Œuvres de Lagrange*, Vol. XI, pp. 323-324; *Ostwald's Klassiker*, 167, pp. 11, 49.

action transforms into

$$\int 2T.dt,$$

and "therefore the principle in question reduces to this: the sum of the instantaneous *vires vivae* of all the bodies, from the moment when they start from given points to that when they arrive at other given points, is a maximum or a minimum. We might, then, call it, on better grounds, the *principle of the greatest* or *smallest vis viva*, and this way of regarding it would have the advantage of being general, both for motion and for equilibrium, since we have seen, in the third section of the first Part (art. 22), that the *vis viva* of a system is always a maximum or a minimum in a position of equilibrium."

In the second and subsequent editions of the *Mécanique*, articles 21-27[29] are under the heading: "Propriétés de l'équilibre, relatives aux maxima et minima," and correspond to articles 13-20 of the third section of the first part of the first edition.[30] In the 22d article of the second edition,[31] Lagrange proved, by using the equation of *vis viva*, Courtivron's principle that, of all the positions which the system successively takes, the one in which it has the greatest or the least *vis viva* is the same as that in which it must be placed in order that it may remain in equilibrium. Then Lagrange[32] proved that when the function considered is a minimum the equilibrium will be stable, and unstable if the function is a maximum. In the second edition Lagrange[33] gave a new proof of this theorem, and Dirichlet[34] simplified this proof and made it more rigorous.

Lagrange[35] mentioned that the principle that the function which he denoted by Π, and which is known as the "work-function" or the "force-function," is a maximum or a minimum in the case of equilibrium, is in what Maupertuis's "Loi de Repos" consists.

It must be remembered that as a matter of fact Maupertuis merely said that his function was a *minimum* for equilibrium, and

[29] *Œuvres*, Vol. XI, pp. 69-76.

[30] *Méchanique analitique*, Paris, 1788, pp. 36-44.

[31] *Œuvres*, Vol. XI, p. 70. This is exactly reproduced from the 15th article of the first edition (pp. 37-38), with the exception that, whereas the name of de Courtivron alone is cited in the first edition, in the second the Paris *Mémoires* of 1748 and 1749 alone are cited.

[32] *Méchanique*, pp. 38-44.

[33] *Œuvres*, Vol. XI, pp. 70-74.

[34] *Journ. für Math.*, Vol. XXXII, 1846, pp. 85-88; *Werke*, Vol. II, pp. 5-9; French translation in *Journ. de Math.*, Vol. XII, 1847; *Œuvres de Lagrange*, Vol. XI, pp. 457-459.

[35] *Méchanique*, p. 37 (cf. p. 11); *Œuvres*, Vol. XI, p. 69 (cf. p. 22).

he emphasized that the "Law of Rest" was only a special case of the principle of least action. It was essential for him to fix his attention solely on the minimum if he wished to prove that the Creator was economical, and not spendthrift. It was Euler who first drew the more[36] correct conclusion that the function is a maximum or a minimum and gave a correct sketch of the connection of the minimum with stability and the maximum with instability. These investigations have already been fully described,[37] and we need only indicate how Maupertuis's "Law of Rest" is related to the principle of least action.

The general variational principle (of Hölder) of which Hamilton's principle and the principle of least action are particular cases is[38]

$$\int \{2T.d\delta t + (\delta T + \delta U)dt\} = 0$$

where the integral is to be taken between the limits t_0 and t_1, and the symbol "δU" does not imply that a force-function U exists.[39] In the statical case, $T = 0$, so that we get

$$\int \delta U.dt = 0.$$

As this holds for all virtual displacements (marked by "δ") we have simply

$$\delta U = 0,$$

and this is the "Law of Rest."

IV.

Maupertuis's words:[40] "When some change happens in nature, the *quantity of action* [that is to say, 'the product of the mass of the bodies by their velocity and by the space which they describe,' a phrase which means Σmvs] necessary for this change is the smallest possible," has been interpreted to mean only changes of velocity. But this is not what Maupertuis plainly meant at first, in the case of the motion of light.[41] And if a body moves uniformly along the x-axis, there is change always going on; the velocity v or s/t is con-

[36] Even in Euler's and Lagrange's works, the occurrence of neutral equilibrium is not considered. On the whole question, see Mach, *Mechanics*, pp. 68-73.

[37] *Monist*, Vol. XXII, pp. 421 (note 35) etc.

[38] *Ibid.*, p. 300.

[39] *Ibid.*, p. 290.

[40] *Monist*, Vol. XXII, p. 420.

[41] *Ibid.*, p. 418. Maupertuis's calculation of the path of light was, in spite of Mach's statement to the contrary, consistent with this (*ibid.*, pp. 285-286, 418-419, note 19).

stant, and the total action in the space s described in time t is mvs or mv^2t. Again, if a mass m is under no forces, if we minimize the action $\int m.v.ds$, we find that $m.d^2x/dt^2 = 0$, and two similar equations in y and z. But, in his problems on impact, Maupertuis[42] changed his conception of "action" to one which seemed to suit his purpose better. This new conception was the quantity

$$A(a-x)^2+B(x-b)^2,$$

and so obviously the action of A, if its velocity were unaltered by impact, would be zero, whereas we have just seen that a body under inertial conditions has non-zero "action" according to Maupertuis's first definition.

Indeed it seems likely that d'Arcy[43] was right in conjecturing that Maupertuis merely chose his formula for the "action" so that, when minimized, it gave the results he wanted. In fact he did dishonestly, pretentiously, and unskilfully what Euler[44] did honestly, humbly, and skilfully.

Suppose, with Maupertuis,[45] that the inelastic A and B move with the respective velocities a and b in a straight line and in the same sense. Let A start behind B and catch it up, and then, after the impact, let both move with the common velocity, u, less than a and greater than b.

It must be remembered that Newton[46] had made a series of careful experiments on impact, the result of which may be expressed as follows: If u and u' are the velocities of the spherical masses m and m' in the line of their centers and in the same sense before impact, and v and v' their velocities in the same line and sense after impact, then

$$v-v' = -e(u-u'),$$

where e is a positive fraction which is independent of the masses and velocities of the bodies and is now called "the coefficient of restitution." The limiting cases, where e is zero or unity, were chiefly discussed in the eighteenth century: when $e = 1$, the bodies are said to be "perfectly elastic"; when $e = 0$, they are said to be "inelastic" or "hard." Very soft bodies, like putty or wool, are almost inelastic;

[42] *Ibid.*, pp. 421, 446-447, 451, 452, 455. Cf. Mach's *Mechanics*, p. 368.

[43] *The Monist*, Vol. XXIII, p. 447. Bertrand's objections (*ibid.*, p. 456) are simply due to the fact that he misunderstood d'Arcy's (badly chosen) notation $P^2 = \int \Phi.dx$, and so on.

[44] *Ibid.*, p. 437.

[45] *Ibid.*, p. 421.

[46] Scholium to the Laws of Motion in the *Principia*.

but so also obviously would a perfectly rigid body be. The epithet "hard" arose owing to the exclusive consideration of rigid bodies as inelastic. Problems about the impact of elastic and inelastic bodies were then in the focus of interest. This was partly due to the emphasis laid on the principle of *vis viva* by Huygens and Leibniz.[47] In the case of impact, this principle only holds when $e=1$.

Returning to Maupertuis's problem, at a certain instant A and B both start from given points. Both A and B move towards the origin. Let us suppose that after impact the motion continues with the common velocity u, constant or not. We have to find u. In Maupertuis's principle we consider the whole class of motions obtained by giving u different values, so that the mass consisting of A and B together reach the origin at different times in the members of the class of motion considered. Of this class of motions we have to seek out that motion which the "action" is the least. Keeping to Maupertuis's first definition of "action," we can put the problem into the variational form

$$\delta\Sigma m\int v.ds=0,$$

or

$$\Sigma m\int(\delta v.dx+v.d\delta x)=0$$

where v is dx/dt. As there are no external forces, $\delta U=0$, and so the terms $m.\delta v.dx$ are zero. Integrating by parts, we get

$$\Sigma m\int dv.\delta x=0,$$

and, since δx is arbitrary,

$$\Sigma m.dv=0,$$

or Σmv is constant. Thus, for inelastic masses

$$u(A+B)=Aa+Bb$$

while, for elastic masses, α and β are given by

$$A\alpha+B\beta=Aa+Bb,\ \beta-\alpha=a-b.^{48}$$

With regard to Maupertuis's treatment of the lever,[49] it is to be noticed that the forces on A and B were not explicitly considered by Maupertuis. This is the principal defect[50] in his formulation. In the cases of impact considered there were no external forces; but, if there are external forces, we must assume that they are expres-

[47] *Monist*, Vol. XXII, pp. 424-425; Mach, *Mechanics*, pp. 317, 326, 274-276.

[48] *Monist*, Vol. XXII, pp. 422, 447 (note 152).

[49] *Monist*, Vol. XXII, pp. 422, 448, 452-453, 455.

[50] Mach, *Mechanics*, p. 366.

sible in terms of the masses and velocities by the principle of *vis viva* or its generalization. What we need, as Lagrange showed, is the equation $\delta T = \delta U$; and a sufficient condition for this is the equation $T = U + h$. The equation of *vis viva* is not a necessary condition for the subsistence of the equation $\delta T = \delta U$, as I have often remarked above.[51] But without the condition $\delta T = \delta U$ the principle of least action is meaningless.

It seems to me very possible that, in this consideration about the lever, Maupertuis was wishing to assert Courtivron's theorem[52]—a deduction from Maupertuis's "Law of Rest"—that the *vis viva* was a maximum when the system passed through a position of stable equilibrium. At any rate, Maupertuis later[53] emphasized that the principle of least action reduced, in the statical case, to the "Law of Rest." Euler mentioned[54] the problem of the lever with approval, and he could hardly have gone so far as this if it did not seem capable of a valid interpretation.

It is not easy to see how Maupertuis could have reasonably maintained this without granting that the principle of *vis viva* is to hold. And yet this would unfit the principle of least action for dealing with the impact of inelastic bodies. This difficulty must have presented itself to Euler, but he did not mention it. It was Lagrange[55] who solved it, and showed how $\delta \Sigma \int m.v.ds = 0$ had a mechanical meaning: v was a function of s, even though we cannot say that $T = U + h$. But Lagrange seems to have forgotten his advance, and it only showed itself again in Hölder's work.

Maupertuis is, then, right; but he gave no valid reason in support of his thesis. He was unpardonably obscure, and not always, perhaps, unwilling to pretend that he saw truths where he did not but would have liked to. D'Arcy criticized Maupertuis rather destructively, and d'Arcy was often right. Where he was wrong Maupertuis did not see, except in one thing: the definition of "action."[56]

PHILIP E. B. JOURDAIN.

CAMBRIDGE, ENGLAND.

[51] *Monist*, Vol. XXII, pp. 457, 289-290.

[52] See Section III above.

[53] *Monist*, Vol. XXII, pp. 420-421, note 35.

[54] *Ibid.*, p. 436.

[55] *Ibid.*, pp. 289-290.

[56] *Ibid.*, pp. 445, 450, 454.

LA METTRIE'S VIEW OF MAN AS A MACHINE.[1]

Summed up briefly, the facts of Julien Offray de la Mettrie's life are as follows: He was born December 25, 1709, in St. Malo. He first studied the humanities with brilliant success at the college of Coutances and then in Paris. In 1725 he studied natural philosophy at the college of Harcourt and took the degree of doctor of medicine at Rheims and began to practice there. In 1733 he went to Leyden and studied under Boerhaave. The next year he translated a treatise of his master and added to it an original work of his own which gained him the jealousy of older physicians. The next years were spent in St. Malo where besides carrying on an active practice he translated and wrote medical works of original value. In 1742 he went to Paris and became physician of the guards but lost his patron, the Duke of Gramont, in an early battle. In the same campaign, La Mettrie suffered from a severe fever, and after his recovery had his philosophic conjectures printed under the title "The Natural History of the Soul." This work aroused the wrath of the theologians and in 1746 he went to Leyden to philosophize in peace. Here he wrote "Penelope," a satire on quackery, and "Man a Machine." The latter brought down upon him the displeasure of the Leyden clericals of all denominations. His genius and unfortunate condition procured him a refuge in Prussia with a pension from Frederick the Great. He went to Berlin in 1748 where he was made a member of the Royal Academy of Science. He died November 11, 1751, leaving a widow and a five year old daughter. His royal patron closed the eulogy which he wrote for the Royal Academy with these words:

"La Mettrie was born with a fund of natural and inexhaustible gaiety; he had a quick mind, and such a fertile imagination that it made flowers grow in the arid field of medicine. Nature had made him an orator and a philosopher; but a yet more precious gift which he received from her was a pure soul and an obliging heart. All those who are not imposed upon by the pious insults of the theologians mourn in La Mettrie a good man and a wise physician."

During his life La Mettrie was subject to persecutions and also to the disappointment that he found no serious treatment of the great problem he had raised among men of science but on the con-

[1] An English translation of La Mettrie's well-known work, *L'homme machine*, has recently been published by The Open Court Publishing Company (Chicago, 1912) with philosophical and historical notes by Gertrude Carman Bussey.

trary was pelted with dirty accusations. He was of a buoyant temperament, and during the worst times of his life he laughed at trouble and showed himself ready to go down in the shipwreck of the storm which his bold love of truth had provoked. As an instance of the attacks to which he was exposed, we quote one of the opinions of the historians of philosophy uttered by Professor Hettner, who says of him: "Lamettrie is a bold libertine who sees in materialism only the justification of his profligacy," and this opinion is recorded in one of the best histories of philosophy.

JULIEN OFFRAY DE LA METTRIE.

A contemporary artist, G. F. Schmidt, made an engraving of the ridiculed advocate of mechanicalism with the intention of representing him as Democritus the laughing philosopher. It is the only portrait of him that has come down to us, and since La Mettrie at the time was an object of general contempt it attracted a good deal of attention. A French actor and a friend of La Mettrie, M. Désormes, had the picture accompanied by a few French lines which read as follows:

"Sous ces traits vifs, tu vois le maître
Des jeux, des ris et des bons mots;
Trop hardi d'avoir de son être
Osé débrouiller le cahos.
Sans un sage il était la victime des sots."

We translate these lines as follows:

"These features show truly the master
Of jollities, laughter and wit;
Too bold he was in his nature
To take off the corners of it.
He would have been but for one sage
The victim alas! of the fools of his age."

Lessing the great art critic not only of his age, but probably of all time, saw this picture and used it as an instance to prove one of his theories. He was not an admirer of La Mettrie, and seeing in the sarcastic laugh of this modern Democritus a grin, he condemned in a rather hasty and overcritical mood all the pictures which portrayed laughing faces.

Lessing says in his *Laokoon*: "La Mettrie who had himself painted and engraved as a second Democritus laughs only the first time one looks at him. Repeated contemplation changes the philosopher into a fool, his laughter changes into a grin." On the basis of this instance Lessing declares that neither a sculptor nor a painter should represent anything that can not but be transitory, because phenomena which burst out suddenly and disappear at once, as for instance laughter, produce through their prolongation in art an unnatural and therefore unpleasant impression, which changes what might be pleasant into something disgusting and repelling. This view goes too far. With all due respect for Lessing's ability as a critic, we do not share his opinion in this special point. It is by no means inadvisable to paint galloping horses or flying birds or a dancing Bacchante. We deem it quite possible to present laughing portraits which will always remain pleasant, but in the present case we must bear in mind that the artist intended to depict a sarcastic grin rather than an amiable smile. La Mettrie's character was not such as to win the sympathy of his contemporaries; he ridiculed others with biting sarcasm and, as expressed in the verse of Désormes, he disdained to take off the corners of his satirical nature.

La Mettrie was the first to uphold in unmistakable language the application of the mechanistic principle to man. In addition to publishing his book *L'homme machine* he carried on a long and interesting controversy with his adversaries, among whom his main victim was the famous naturalist Haller, a Swiss by birth, a poet and at the same time professor of medicine in the University of Göttingen.

La Mettrie's significance in the history of philosophy has sometimes been underrated and is now often overrated. He is decidedly a prominent thinker, a representative of a great and important truth, the mechanistic principle, and he has brought it before the public in a most forcible way so as to have it connected with his name for all time to come. He was a martyr of his cause, and, in fear of being lynched, he had to flee from France and again from Holland, without being able to take with him any property nor even sufficient clothes for the journey, but he had the good fortune to be protected by a royal genius, the great and noble king Frederick the Second of Prussia, who was rightly surnamed the Great not only because he gained many victories on the battlefield against great odds, but above all because he was a philosopher on the throne.

It is a pity that La Mettrie, this clear thinker and exact scientist, was yet small enough to attack his enemies in a sarcastic way which ought to have been beneath the dignity of so great a man. Poor Haller, trained in the ponderous methods of German science, a pious Christian of a most reactionary and dogmatic trend of thought, was scarcely a match for the nimble wit of his French antagonist and so he fell repeatedly a prey to the traps which La Mettrie laid for him. Haller did not even understand the irony with which La Mettrie dedicated to him the book *L'homme machine,* and he did not see that the plagiarism which his enemy committed was really a satire and a parody. La Mettrie published a French translation of Haller's love verses and praised the poet, but in doing so La Mettrie sarcastically turned Haller's tender sentiments into frivolous jokes.

We can easily understand how an impartial reader of *L'homme machine* will become prejudiced against the author by the vulgar instances which are introduced to prove the contention of the book. La Mettrie would have been a better representative of his theory if his presentation had been more dignified, and if he had abstained from the improprieties of his humor.

Without shutting our eyes to all his shortcomings we do not mean to belittle La Mettrie or to depreciate the work he has done for a great cause. Let us remember what his noble protector Frederick the Great said about him in his eulogy when he praised not only the high standing of his philosophical compass but also the purity of his life which was indubitable in spite of the cynicism of his language.

La Mettrie's sarcasm lays him open to the suspicion of malevo-

lence, but we know through Frederick the Great that he was an amiable friend and it is not likely that his satirical view need be interpreted as a mean streak in his character. We can not assume that he took delight in hurting the feelings of others, but we may easily understand how the witty Frenchman enjoyed a laugh at his enemies' expense and how difficult it was for him to suppress a joke—especially if the joke served a higher purpose, if it helped to point out the truth of his cause.

A key to the motive of La Mettrie's sarcasm and his disregard for the feelings of others may be found in the preface to the edition of his collected works where he confesses to cling to the principle thus expressed: "Write as if thou wert alone in the universe and hadst nothing to fear from the jealousies and prejudices of the people. Otherwise thou wilt miss thy purpose."

It has been pointed out by Friedrich Albert Lange and others, that there is not the slightest reason to doubt the sincerity of La Mettrie's work. Certainly he did not seek pecuniary gain, for he could have fared much better in life if he had kept quiet. He was an able and very successful physician and we learn from his medical satires that he knew but too well how much better quackery paid than a rational and honest treatment of patients. In fighting for honesty in the medical profession, he knew that he would encounter much hostility, yet he preferred stating the truth to the easier method of following the ways of his colleagues by gaining the confidence of the powerful and influential to his own advantage.

We need not approve of La Mettrie's methods in order to think that there is no reason to doubt his good intention when holding up his opponents to ridicule, and some of them too are certainly at fault, for their accusations of licentiousness have never been proved. Even his enemies have never produced anything positive against him which would show his character in a bad light. Though it would be out of place to present him as a saint, we have no reason to assume that he was worse than the average men of his time. One of the worst accusations that have repeatedly been urged against him was the good word he spoke in defense of criminals, and yet herein we must recognize that in the progress of civilization the same thought has been expressed by judges as well as by the public in general, and our present methods of treating criminals has decidedly approached La Mettrie's conception of justice.

We must recognize that La Mettrie has become the scapegoat of materialism, and thinkers who accept his very theories have long

been in the habit, as F. A. Lange pointed out, of excusing themselves by denouncing La Mettrie, and pouring out upon his head the vials of their indignation, protesting that they themselves were not of his type. It was a cheap way of gaining the reader's *captatio benevolentiae*, at the cost of a much maligned representative of materialism.

La Mettrie remained the scapegoat of an ostracized philosophy until Friedrich Albert Lange turned the tide. In his *History of Materialism*, Lange stood up for La Mettrie and corrected the wrong impressions, due to slander and misrepresentation. Lange's chapter on La Mettrie as the most prominent and most consistent representative of materialism[2] is probably still the best that has been written on him. It has been well supplemented recently by Dr. Ernst Bergmann, a *Privatdozent* of Leipsic, in his little book *Die Satiren des Herrn Maschine* (Leipsic, 1913).

We sum up: La Mettrie states an important truth and we grant that all motions, including the entire activity of the human brain, are mechanical and that therefore and in this sense man is a machine. On the other hand we do not hesitate to condemn in La Mettrie his onesidedness, the impropriety of his presentation in some details and the sarcastic manner of his polemics.

By means of short extracts we will let La Mettrie state his position so that the reader can easily form his own opinion of it. He says:

"It is not enough for a wise man to study nature and truth; he should dare state the truth for the benefit of the few who are willing and able to think. As for the rest, who are voluntarily slaves of prejudice, they can no more attain truth, than frogs can fly.

"I reduce to two the systems of philosophy which deal with man's soul. The first and older system is materialism; the second is spiritualism."

La Mettrie claims that his theory is based on experience, but obviously experience is not in favor of the mechanistic theory. Our belief in mechanicalism is the result of a purely *a priori* consideration. Even at the present day chemistry must confess that a mechanical explanation of strictly chemical processes is as yet impossible. We must assume the theory of mechanicalism as an inevitable conclusion of the principle that all changes are transformation, but we have not yet demonstrated this conclusion in experience.

A chemical combination shows absolutely new qualities which

[2] *Geschichte des Materialismus*, Part IV, Chapter 2. (Vol. I, pp. 326,359.)

can not be explained as a mixture of the qualities of its ingredients, and we have as yet no means to account for higher combinations by a mechanical interaction. Nevertheless many chemists accept the mechanistic principle as applicable to chemical combinations because speculation can discover no other way of explaining processes of any kind than as results of a mechanical interaction or cooperation of parts. Under these conditions we see ourselves obliged to assume that there is a molecular mechanics, the proportions of which, however, are too infinitesimally small for our best microscopes to make visible. Accordingly we must be satisfied with the belief that ultimately they are mechanical. So far at least we know nothing to the contrary, nothing that would definitely destroy our hope that there are no processes the nature of which could not ultimately be explained by the interrelations of their parts.

La Mettrie is unconscious that he is arguing *a priori*, and it is a common occurrence that those naturalists who clamor most for the necessity of limiting science to experience are most strongly carried away by *a priori* methods. They believe that we must rely on experience alone, and should not be allowed to generalize; yet naturalists of this type are most insistent in declaring that natural laws suffer no exceptions. The statement may be true enough, but it can never be proved by experience nor by induction; in its sweeping universality it is obviously a deduction from general principles. La Mettrie is no exception to the general rule, and his many evidences of the interconnection between soul and body, true as they may be, can not carry conviction, because they prove nothing but the fact stated, i. e., an interconnection between soul and body, not their identity.

"Man is so complicated a machine that it is impossible to get a clear idea of the machine beforehand, and hence impossible to define it. For this reason, all the investigations have been vain, which the greatest philosophers have made *a priori*, that is to say, in so far as they use, as it were, the wings of the spirit. Thus it is only *a posteriori* or by trying to disentangle the soul from the organs of the body, so to speak, that one can reach the highest probability concerning man's own nature, even though one can not discover with certainty what his nature is.

"Let us then take in our hands the staff of experience, paying no heed to the accounts of all the idle theories of philosophers. To be blind and to think that one can do without this staff is the worst kind of blindness. How truly a contemporary writer says that only

vanity fails to gather from secondary causes the same lessons as from primary causes!"

It is true enough that we need the staff of experience; we must investigate the facts, but our main conclusion will be the result of a deduction from general principles. Who for instance can prove the truth of evolution from experience? How is it possible to collect all the facts in question? There is so much talk about the missing link! We ought to bear in mind that if one link in the chain is discovered there are others missing. In all scientific reasoning we have to employ both the method of logic, which is *a priori*, and of the facts of experience, which is *a posteriori*. The two are the web and woof of all scientific work and without either our endeavor to widen the horizon of our positive knowledge will yield no profit.

Here are specimens of La Mettrie's arguments:

"In disease the soul is sometimes hidden, showing no sign of life; sometimes it is so inflamed by fury that it seems to be doubled; sometimes, imbecility vanishes and the convalescence of an idiot produces a wise man. Sometimes, again, the greatest genius becomes imbecile and loses the sense of self. Adieu then to all that fine knowledge, acquired at so high a price, and with so much trouble! Here is a paralytic who asks if his leg is in bed with him; there is a soldier who thinks that he still has the arm which has been cut off. The memory of his old sensations, and of the place to which they were referred by his soul, is the cause of his illusion, and of this kind of delirium. The mere mention of the member which he has lost is enough to recall it to his mind, and to make him feel all its motions; and this causes him an indefinable and inexpressible kind of imaginary suffering. This man cries like a child at death's approach, while this other jests. What was needed to change the bravery of Caius Julius, Seneca, or Petronius into cowardice or faintheartedness? Merely an obstruction in the spleen, in the liver, an impediment in the portal vein. Why? Because the imagination is obstructed along with the viscera, and this gives rise to all the singular phenomena of hysteria and hypochondria.

"What can I add to the stories already told of those who imagine themselves transformed into wolf-men, cocks or vampires, or of those who think that the dead feed upon them? Why should I stop to speak of the man who imagines that his nose or some other member is of glass? The way to help this man regain his faculties and his own flesh-and-blood nose is to advise him to sleep on hay, lest he break the fragile organ, and then to set fire to the hay that he

may be afraid of being burned—a fear which has sometimes cured paralysis.....

"As the motion of the blood is calmed, a sweet feeling of peace and quiet spreads through the whole mechanism.....

"Is the circulation too quick, the soul can not sleep. Is the soul too much excited, the blood can not be quieted: it gallops through the veins with an audible murmur. Such are the two opposite causes of insomnia.....

"The human body is a machine which winds its own springs. It is the living image of perpetual movement. Nourishment keeps up the movements which fever excites. Without food, the soul pines away, goes mad, and dies exhausted.....

"Pope understood well the full power of greediness when he said:

> "'Catius is ever moral, ever grave,
> Thinks who endures a knave is next a knave,
> Save just at dinner—then prefers no doubt,
> A rogue with ven'son to a saint without.'

"Elsewhere he says:

> "'See the same man in vigor, in the gout
> Alone, in company, in place or out,
> Early at business and at hazard late,
> Mad at a fox chase, wise at a debate,
> Drunk at a borough, civil at a ball,
> Friendly at Hackney, faithless at White Hall.'....

"Raw meat makes animals fierce, and it would have the same effect on man.....

"We think we are, and in fact we are, good men, only as we are gay or brave; everything depends on the way our machine is running.....

"In general, the form and the structure of the brains of quadrupeds are almost the same as those of the brain of man; the same shape, the same arrangement everywhere, with this essential difference, that of all the animals man is the one whose brain is largest, and, in proportion to its mass, more convoluted than the brain of any other animal.....Fish have large heads, but these are void of sense, like the heads of many men. Fish have no *corpus callosum*, and very little brain, while insects entirely lack brain.....

"I shall draw the conclusions which follow clearly from these incontestable observations: 1st, that the fiercer animals are, the less brain they have; 2d, that this organ seems to increase in size in proportion to the gentleness of the animal; 3d, that nature seems

here eternally to impose a singular condition, that the more one gains in intelligence the more one loses in instinct.

"Do not think, however, that I wish to infer by that, that the size alone of the brain, is enough to indicate the degree of tameness in animals; the quality must correspond to the quantity, and the solids and liquids must be in that due equilibrium which constitutes health.

"If, as is ordinarily observed, the imbecile does not lack brain, his brain will be deficient in its consistency—for instance, in being too soft. The same thing is true of the insane, and the defects of their brains do not always escape our investigation. But if the causes of imbecility, insanity, etc., are not obvious, where shall we look for the causes of the diversity of all minds? They would escape the eyes of a lynx and of an argus. A mere nothing, a tiny fibre, something that could never be found by the most delicate anatomy, would have made of Erasmus and Fontenelle two idiots, and Fontenelle himself speaks of this very fact in one of his best dialogues."

In comparing the morality of animals and men, La Mettrie censures human behavior, for, says he,

"Our compatriots fight, Swiss against Swiss, brother against brother, recognize each other, and yet capture and kill each other without remorse, because a prince pays for the murder."

He has an excuse for criminals, saying:

"I believe and admit that these wretches do not for the most part feel at the time the enormity of their actions.....But it is much to be wished that excellent physicians might be the only judges.....If crime carries with it its own more or less cruel punishment, why should we frighten the imagination of weak minds by a hell?"

La Mettrie's sarcasm comes out in his presentation of the case of theism *vs.* atheism. He claims to be the skeptic who would remain impartial. He pretends to have a leaning towards theism and introduces his atheistic views by some Pyrrhonian, whom he incidentally calls "this wretch" (*cet abominable homme*):

"I do not mean to call in question the existence of a supreme being; on the contrary it seems to me that the greatest degree of probability is in favor of this belief. But since the existence of this being goes no further than that of any other toward proving the need of worship, it is a theoretic truth with very little practical value. Therefore, since we may say, after such long experience, that re-

ligion does not imply exact honesty, we are authorized by the same reasons to think that atheism does not exclude it.....

"Let us not lose ourselves in the infinite, for we are not made to have the least idea thereof, and are absolutely unable to get back to the origin of things. Besides it does not matter for our peace of mind, whether matter be eternal or have been created, whether there be or be not a God. How foolish to torment ourselves so much about things which we can not know, and which would not make us any happier even were we to gain knowledge about them!....

"I do not take either side.

"'Non nostrum inter vos tantas componere lites.'

"This is what I said to one of my friends, a Frenchman, as frank a Pyrronian as I, a man of much merit, and worthy of a better fate. He gave me a very singular answer in regard to the matter. 'It is true,' he told me, 'that the *pro* and *con* should not disturb at all the soul of a philosopher, who sees that nothing is proved with clearness enough to force his consent, and that the arguments offered on one side are neutralized by those of the other. However,' he continued, 'the universe will never be happy, unless it is atheistic.' Here are this wretch's reasons. If atheism, said he, were generally accepted, all the forms of religion would then be destroyed and cut off at the roots. No more theological wars, no more soldiers of religion—such terrible soldiers! Nature infected with a sacred poison, would regain its rights and its purity. Deaf to all other voices, tranquil mortals would follow only the spontaneous dictates of their own being, the only commands which can never be despised with impunity and which alone can lead us to happiness through the pleasant paths of virtue.

"Such is natural law: whoever rigidly observes it is a good man and deserves the confidence of all the human race. Whoever fails to follow it scrupulously affects, in vain, the specious exterior of another religion; he is a scamp or a hypocrite whom I distrust.....

"We do not seek here the votes of the crowd. Whoever raises in his heart altars to superstition, is born to worship idols and not to thrill to virtue.

"But since all the faculties of the soul depend to such a degree on the proper organization of the brain and of the whole body, that apparently they are but this organization itself, the soul is clearly an enlightened machine. For finally, even if man alone had received a share of natural law, would he be any less a machine for that?"

La Mettrie's conclusion is this:

"The soul is therefore but an empty word, of which no one has any idea, and which an enlightened man should use only to signify the part in us that thinks.... He is to the ape, and the most intelligent animals, as the planetary pendulum of Huyghens is to a watch of Julien Leroy..... I believe that thought is so little incompatible with organized matter, that it seems to be one of its properties on a par with electricity, the faculty of motion, impenetrability, extentension, etc."

As to our destiny after death La Mettrie again introduces a bit of sarcasm and under the pretext of skepticism argues in favor of the possibility of immortal machines. Stating that "we know absolutely nothing about the subject," he continues:

"To assert that an immortal machine is a chimera or a logical fiction, is to reason as absurdly as caterpillars would reason if, seeing the cast-off skins of their fellow-caterpillars, they should bitterly deplore the fate of their species, which to them would seem to come to nothing. The soul of these insects (for each animal has its own) is too limited to comprehend the metamorphoses of nature. Never one of the most skilful among them could have imagined that it was destined to become a butterfly. It is the same with us. What more do we know of our destiny than of our origin? Let us then submit to an invincible ignorance on which our happiness depends."

It is worth while noticing that the practical application of his views comes ultimately to the same kind of ethics that religious people would preach.

"On the other hand, there is so much pleasure in doing good, in recognizing and appreciating what one receives, so much satisfaction in practising virtue, in being gentle, humane, kind, charitable, compassionate and generous that I consider as sufficiently punished any one who is unfortunate enough not to have been born virtuous.....

"He who so thinks will be wise, just, tranquil about his fate, and therefore happy. He will await death without either fear or desire, and will cherish life (hardly understanding how disgust can corrupt a heart in this place of many delights); he will be filled with reverence, gratitude, affection, and tenderness for nature, in proportion to his feeling of the benefits he has received from nature; he will be happy, in short, in feeling nature, and in being present at the enchanting spectacle of the universe, and he will surely never destroy nature either in himself or in others. More than that! Full of humanity, this man will love human character even in his enemies.

Judge how he will treat others. He will pity the wicked without hating them; in his eyes, they will be but mis-made men. But in pardoning the faults of the structure of mind and body, he will none the less admire the beauties and virtues of both....and following the natural law given to all animals, he will not wish to do to others what he would not wish them to do to him.

"Let us then conclude boldly that man is a machine, and that in the whole universe there is but a single substance differently modified.....Such is my system, or rather the truth, unless I am much deceived. It is short and simple. Dispute it now who will."

P. C.

THE SPIRIT IN THE WHEELS.

THE MECHANISM OF THE UNIVERSE AS SEEN BY A THEIST.

Dr. James Thompson Bixby has published under the title *The Open Secret* a book which he characterizes as "A Study of Life's Deeper Forces,"[1] and the first problem he attacks is the question of vitality and mechanism. All other problems which he discusses are mere side issues. They are treated in nine more chapters entitled: The Cosmic Motor Power, Atom and Spirit, Purpose in Nature, Law and Providence, Good the Final Goal, Fate or Choice, Our Self-Made World, Partners in World-Making, Search the Deep Things.

Dr. Bixby is a theist; he recognizes the significance of mechanism, but takes his stand on vitalism. He finds the most appropriate allegory for his view in Ezekiel's vision of the winged cherubim, which has been called the "spirit of the living creatures in the wheels." He grants that the mechanics of these wheels is impossible, nevertheless the general idea symbolized by this vision is not merely quite rational but most significant and instructive.

Dr. Bixby continues: "The essential lesson of the vision is that every living creature has around him some revolving machinery, and that within all the mechanical wheel-works which are visible there is a living soul as the motor power and directing agency of the enclosing enginery."

Dr. Bixby's book is written from the standpoint of an advanced teleology. The author is sufficiently acquainted with modern science to understand the scientific position and states it in fairness and without animosity; yet he condemns it not only as utterly wrong, but also as chilling our faith and as dangerous.

[1] Published by the American Unitarian Association, Boston, 1912.

We will here state Dr. Bixby's position in his own words without any criticism on our part, referring our readers to our own solution of the same problem presented in the editorial article on mechanicalism.

The Contrast of the Old and New Views.

"To the chanters of the Vedas every flickering flame was a living creature, an appearance of Agni, the fire god; the Greeks beheld in every rustling tree a dryad, in every babbling fountain a water nymph. The prevalent faith of all the early nations, as of savages to-day, was similar. Sun and moon, cloud and storm, evening breeze, each had its impelling divinity. Each spirit followed his own caprice on the impulse of the moment. Nowhere was there any fixed order. With the ascent of thought to the higher faith of monotheism, the only change, for a long time, was that every catastrophe or trouble was interpreted as a retribution sent from the Supreme God upon the sufferer for some known or secret sin. Life was a succession of special providences, and the career of every prophet or saint a series of signs and wonders, manifesting the direct intervention of the Most High.

"Our modern thought, however, has gone to the very opposite extreme. No wind bloweth where it listeth; the wildest gust has its appointed course from which it cannot swerve.

"By uniform laws, every continent has been moulded and uplifted. By simple processes of variation, struggle for existence and accumulation of hereditary gains, the rudimentary creatures have developed into complex and elaborate organisms. In all these diverse species, in all their ingenious organs and vital adjustments, in the rise, growth and decay of nations, and in the most astonishing coincidences of personal or social events, modern science sees only the products of that great machine-shop of interacting, unresting wheels of law and force that we call nature."

In the New View There is no Room for God.

"The natural result of this extension of the network of law and its mechanical processes over the whole universe is at first most chilling to faith. When the believer who has been brought up in the common conception of the Deity as a vague presence immensely greater than man, but with the personal loves and dislikes, moods of wrath, pity, imperfect counsels, changeable purposes and incomplete forethought which are characteristic of humanity—when such a believer, I say, comes by scientific investiga-

tion to abandon these ideas, what a loss he feels! In what a freezing waste and friendless world he seems to find himself. Having always thought of God as the great intervener and repairer of the cosmic system, manifest in every mystery or eccentricity of the processes of nature, this reduction of the perturbations and irregularities of the world to mechanical laws seems to banish God from the universe....God has seemed to be pushed outside the verge of his own universe and made henceforth a superfluous hypothesis."

The Machinery of Life.

"The very condition of vitality seems to be this constant rotary motion. In man, the blood under the unwearied beat of the heart must course out to the capillaries and brain cells with its fresh supplies of nutriment and energy and must then flow back again to the lungs to become purified and recharged with oxygen. The nerve currents must flow with their sense impressions from the surface up the sensory nerves to the brain and back again in appropriate motor responses to the muscles. In lung, heart, ganglion, blood corpuscle, cell and molecule, there is a constant round. There is continual efflux and influx, consumption and replenishment. It is only by this ceaseless dying and as ceaseless rebirth, that animate beings keep alive.

"And to maintain this circulation of life, what curious and complicated machinery in every part of the body—the valves of the heart, the batteries of the brain, the triangular muscle of the chin, the levers of arm and leg, with their beautiful ball and socket joints, the keyboard of the ear with its three thousand strings, and the hundred other equally ingenious contrivances that make up this moving house of flesh, most of them working so automatically and perfectly that it is only on the occasions that they get out of order that man takes any thought of the complicated mechanisms and delicate adjustments by which he walks and talks and breathes.

"In former days life and mind were fancied to be powers only loosely connected with the grosser flesh into which they were injected. But the investigations of modern physiologists have shown the connection of the vital and mental with their material organs to be of the closest kind....

"Even the mind is dependent on its wheels, its nervous mechanism. Slice off, layer by layer, a pigeon's brains and in the same measure you pare off its power of feeling and of thought. Each of our senses—sight, hearing, smell, language—has its respective

brain-center. Cut out this cerebral seat and the corresponding faculty disappears....

"All these mechanical conditions of life have to be admitted by the candid mind. It is only in the minute and curious detail into which modern research has pushed its probe that there is anything new in this line of facts. The essential truth that a sound mind always depends upon a sound body has been acknowledged for centuries.

"But equally true and equally to be acknowledged is the converse—that for the body's soundness and activity there is needed a healthy and active spirit; it is equally evident that flesh needs soul as much as soul needs flesh.

"The materialist, concentrating his attention solely on the mechanical side of life, of which I have been speaking, would present this as the sum total of vital existence. Animals and men, the lowest star fish and the greatest of poets, (he tells us) are all just so many machines. The food supply determines the egg and the egg produces the bird or bee. As are the respective environments, sense-impressions and links of association, so must be the man's ideas.

"'Without phosphorous no thought,' was the favorite adage of the German man of science, Moleschott. According to naturalistic monism, every act is predetermined by its conditions before it arises. Free choice is a myth, and an idea not generated or conditioned by the physical environment is a chimera. He who is most confident of the dominant power to direct his course is the veriest bit of driftwood in the eddies of inevitable destiny.

"Such are the superficial dicta of the materialists....If it [the body] is an engine, then it is one that contains within an automatic registry of the experience of its ancestors for centuries; and as Prof. J. Arthur Thomson says: 'It is a self-stoking, self-repairing, self-preservative, self-adjusting, self-increasing, self-reproducing engine.'"

Mind Independent of the Machinery.

"Who ever knew a machine to mend its own breaks and replenish its own wastes? It is by this super-mechanical power, ever superintending, remaking and over-ruling the ordinary chemic and physical tendencies that would disintegrate its parts, that every animate organism lives....

"The mind has a power independent of the forces, whether

material or social, pressing upon it, that may properly be called 'the sovereignty of the self in willing.' Behind all the cerebral machinery there hide, as the main spring that moves it, those noble powers by which man is a living soul and a child of God.....

"Physical force is a constant quantity. But the moral power of the still small voice draws aid from an inexhaustible source to supply whatever energy it needs to overcome the tide of temptation.

"The limited outer view of things that leads so many to a materialistic solution of the great 'World Riddle' is as superficial as it is depressing."

The Explanations of Materialism Insufficient.

"Candid Christian thought must admit the mediation of these mechanisms and wheels—the wheel of evolution, the wheel of heredity, of struggle for existence, of physical conditions and environment, of unbroken order. But scientific thought, if that also is candid, must recognize the living spirit within the wheels as even more essential....

"The materialist who explains life and thought and all the other thousand wonders of the world as but re-arrangements of an original stock of energy and motion in the primal nebula only accounts for the continuance of the world's activities in some shape or other. This account does not explain the wise and orderly direction and harmony of these activities. To account for that we must have a sufficient wisdom and beneficence in the First Cause.....

"That which makes evolution a process of real progress, not a mere swinging round the circle, is the progressive saturation of matter by spirit which it exhibits.....

"In the processes of evolution it is the influences from a higher plane that especially accelerate the development of life. How slow was the upward climb of the vegetable kingdom while its progress was carried forward chiefly by the influence of the environment, fortuitous variation and natural selection.....But when the higher forces of animal desire and visual pleasure and esthetic taste came to act upon it, as bee and moth and butterfly became intermediaries in the work of vegetable union and reproduction, what an amazing diversity of form and glory of adornment, and what rapid ascent in complex organization took place!....If the soul of animal and man has done so much in evolution, how much more ought we to credit to the over-soul?

"When the air plant, hung up in a room, gains weight and

substance, we know there must be in the air itself a source of nutrient supply. So when the minds of men grow and burgeon without visible feeding, we know it is by drawing in and assimilating the invisible spiritual nutriment. It is this continuous communion of the finite with the infinite that we call revelation.....

"We feel justified in saying that feeling, will and thought will be found behind *all* the physical processes of the world as their cause and essence. It is not because of certain breaks in the chain of causality, certain gaps in the line of development of the animal world, or certain missing links between the brute and man that materialism is unsatisfactory and that physical nature demands a God to supplement its insufficiencies. It is for far profounder reasons: it is because all order implies reason; all change implies force; all force implies will. The great tree of life should ever be thought of as an endogenous organism, growing not from without inward, but from within outward.....

"The omniscience of the Infinite One, by its wise provisions, by its skilful, automatic self-adjustments and by the transforming power of the soul's chemistry, provides for the good of all his creatures. Love everywhere hides within these laws. Its pains are but danger signals; its penalties are correctives. This changeless providence, hurting us only when we transgress the divine laws, works ever for greater good. This rigid uniformity and intermediate machinery which we are obliged to master is the means of our education and spiritual development.

"In our personal life and in our interpretation of nature the secret of peace, power and knowledge lies in recognizing these two complementary facts—the outer mechanism and the inner life."

The God Problem.

"What is the *motor power* that has carried the world forward through these countless and constant changes?....

"Matter has no power to move itself. It possesses no spontaneity of action. An essential idea of matter, necessary to all scientific dealing with it, is that of its inertness. If a mass of matter could start itself into motion, or bring itself to a halt, or alter the direction of its motion without the action of something outside of itself, no science of it would be possible."

Arguments Against Theism Answered.

"If the world (as a scientific friend incisively asked me) had a creator, or its organic forms were moulded into their present

shapes and conditions by a reasonable being, would he begin to make a one-toed horse by first making a five-toed creature that climbed trees? To produce a hen, would he start out by making eggs? Or when this creative power wished to make a man, would he, instead of aiming and working directly toward the goal, begin at the bottom of the biologic series by making an ascidian and then change it into a lemurine creature or some other lower animal and then transform that into a simian, and so, by a lengthy circuit, develop the human being, retaining in him numerous survivals of his past which now are apparently quite useless?

"These satiric queries are undoubtedly telling. But do they necessarily compel us to infer absence of purpose, which is the conclusion drawn by Professor Haeckel?

"How is it with a large part of the most rationally planned human work? Does it not accomplish its purpose by decidedly circuitous methods? It is notorious how the iron-moulder begins by making the sand matrix and then breaks it and throws it away. The engineer who builds a stone arch, first puts up the false timber work and then, when he has got his stones in place, pulls down his first wooden structure. Shall we say that the engineer and the iron-moulder have no plan?.... In our English language how many silent letters are there, of no use whatever except as historic monuments of the former spelling and the course of linguistic development!

"Shall we say therefore that there is no purpose in the work of the tailor and printer and that intelligence has had nothing to do with the evolution of language or costume? Is it not possible that the intelligence that works in nature may have a similar historic or esthetic sentiment? Is it not possible that the divine mind (like human minds) may choose to make circuits provided he can thereby accomplish his ends more easily?....

"For my part, I do not see why a theist who maintains that the facts of nature bespeak intelligence in their source is obliged to maintain, also, that nature is as yet a completed work or that the mind, immanent in our part of the cosmos and guiding it, is omniscient.

"While the theist believes in the existence of a supreme being, he may, without inconsistency, suppose that the actual world-building of our solar system may have been delegated to some subordinate divinity, who, though superhuman and wondrously wise and skilful, was not either all-wise or all-powerful. At least, the thinker who

has become an evolutionist will, if he is consistent, never regard that stage and state of nature in which we now live as a finished result beyond which there is to be no more progress."

A Worthy Conception of God.

"For the full satisfaction of the religious instincts, God himself should be recognized as having direct participation in the operations of the world. The spiritual emotions require a present and active God, not an absentee ruler. Our religious intuitions can no more tolerate the idea that the power governing the universe should be blind or subconscious than the reason can tolerate that conception of it that makes it capricious and arbitrary. Only a conscious divine love and life can claim the spirit's loyalty and be recognized by the human soul as sufficiently superior to itself to be worthy of worship. The idea of the world as a titan machine, started and left to itself, is inconsistent with any elevated idea of God.....

"Science is daily coming more and more to the conviction that the cosmos is (to use Humboldt's striking phrase) 'a living whole,' an organism everywhere throbbing with vital power and sensibility struggling for its unfolding into breathing, knowing creature forms. ....The dynamic source of this ceaseless transformation play is a grand energy, more than physical, ever acting, out of an exhaustless life, and from this higher fountain sending down the streams of vitality which circulate through all the veins of the vast, out-spreading cosmos. But energy, according to the testimony of our most eminent philosophers and men of science, we know only as connected with conscious effort, the push or the resistance of the will. Thus at length the vast universe, in all its changing states, its varied phenomena and processes, is found to be a manifestation of personal volition and the action of that guiding mind without which there can be no pressure, effort or direction. As, then, we have to suppose that this guiding mind and energizing will pervade the cosmos wherever energies act, of whom else can they be the attributes than of the One only Infinite—the omnipresent God?"

The Melancholy Teaching of To-Day.

"The older and sterner forms of Christian theology, by their dogmas of predestination and man's natural inability, have been terribly discouraging to human efforts, at least in the moral field..... For many long generations these theological dogmas lay like iron fetters on the mind of man, chaining the will and hardening the

heart. Though in many quarters they still remain, happily they are now fast dissolving beneath the sunlight of modern thought.

'But as these bonds are losing their power, modern science and philosophy are forging new chains, subtler still. From all sides, descend about us the steel wires inscribed: 'Circumstances make the man.' Every act, we are told, is the inevitable outcome of its preceding condition. Every seeming choice is the compulsion of the stronger motive. Free-will is an illusion, exploded now by science. Crime and vice have their averages calculated by the statistician. There were so many hundred murders, so many thousand cases of arson or embezzlement in each of the last ten years. There will be again the same number on the average in the next ten years. Virtue and vice are therefore subject to fixed laws and physical causes, like the return of winter and summer. They are 'merely products of nature,' as Taine says, 'just like sugar and vitriol.'

"The corroding influence of this growing materialism affects all the departments of life. It dissolves the sense of obligation and snatches the crown from virtue to put it on the heads of fact and force.....

"Against this reduction of humanity to a helpless victim of circumstances every virile human being ought vigorously to protest. The soul of man is more than its conditions. The human will is the helm of every human course.

"Do not, however, misunderstand me. I do not mean that human volition, even the most resolute, can do anything that it desires. Our will is by no means wholly free. The term 'free will' describes clumsily and inexactly the great truth that it aims to express. The truth would be better described as the mastership of the mind in choosing and willing."

* * *

We will here make one comment only on Mr. Bixby's advanced view of the old conception of teleology. Mr. Bixby is still a dualist. He extols the spirit that resides in the wheels and regards the mechanism of the machinery which the spirit utilizes as something alien to spirit. We believe that both spirit and machine are one, and the universal dominance of the laws of form determining the detailed uniformities of motion, commonly called mechanics, is by no means a depressing or melancholy thought. The laws of form are the very means in which spirit reveals itself. The human mind is a product of these laws and their eternality may very well be conceived as God immanent in the cosmos, as the divinity which

rules its destinies, as the spirit in the wheels. Keep in mind, however, that there are not two things, the spirit and the wheels, but there is one reality. The cosmic order conceived as the norm of all motions is the spirit, and the details of its actualization are the wheels. Every detailed piece of its mechanism is a direct manifestation of the spirit.

HENRI POINCARE ON THE RELATIVITY OF SPACE.

Whether or not the theories of Henri Poincaré will live long after him is a question of doubt, but it is certain that his method of presenting mathematical problems is very ingenious and attractive. In his article on "The Relativity of Space" we find him grappling with difficulties which are of his own making. But even though we may disagree we follow him with a real satisfaction at the beauty not only of his style but of his very thought and the method by which he reaches his conclusions.

According to our definition space is relativity itself; space being the scope of motion is the condition of tracing distances, and what is distance but the measurable relation of position? In order to do any measurement in space at all we must start in some definite place and consider it as fixed. It serves us as a point of reference. But if we omit to do this, we become involved in a confusion like that of a dizzy man who cannot clearly mark or maintain the direction of his walk. Yet on the basis of this omission of a definite starting-point of reference, M. Poincaré has succeeded with his traditional consideration of the change of the site of the Pantheon in cosmic space, in producing beautiful kaleidoscopic reflections and cogitations on the relativity of space. It is by the same method that Herbert Spencer in omitting to start his space measurements from a reference point derived the notion of the absolute inscrutability of space.[1]

Poincaré's views of space are based ultimately and exclusively on experience, and it seems as if he had forgotten Kant or had never heard of his conception of the *a priori*. We too believe that the idea of mathematical space is derived in its completeness from sense-experience; we believe that only a generalization of a scope of motion, a highly abstract idea of extension with the omission of all particular existences constitutes the basis of space conceptions, and we can construct different kinds of spaces by different modes

[1] See Carus, *Kant and Spencer*, pp. 57-59.

of procedure. All these different spaces are *a priori*, the most complicated as well as the simplest, the one which recognizes parallels in which all lines would meet somewhere at some distances. Our Euclidean geometry does not depend on the constitution of our universe and least of all upon sense-experience but is simply one *a priori* construction among many others. We prefer it because it is the simplest one. It would be by no means impossible to make our computations of the starry heavens on the basis of geometrical construction in curved space, but I fear we shall find no astronomer who would allow himself to be handicapped by the difficulties of a gratuitous curvature when rectilinear figures in their simpler construction are available.

Many incidental remarks in Poincaré's views may be criticised. He condemns such terms as "absolute space" and "distance in itself." He claims that absolute space is meaningless and distance in itself does not exist. We grant both, but would it not be best before condemning these terms to wait until some one uses them and offers us his definition? Newton, for instance, speaks of absolute space and defines it. Though the expression is rather unfortunate we know very well what he meant by it, and we can let it go without assuming that Newton's absolute space is a contradiction or a metaphysical and mystical idea which only betrays a lack of critical acumen in the man who uses it.

A change in size will by no means, as M. Poincaré declares, remain unnoticed or leave everything unaltered. The relation between the radius and the volume of a sphere changes with its size, and the change would produce noticeable results. There is a certain size in which the living cell can maintain its equilibrium and carry out its life functions to greatest advantage, and the same seems to be true of the size of planets. The same is true *mutatis mutandis* in changes by deformation as for instance the reflections in curved mirrors, but though Poincaré's examples are not applicable we are fascinated by his suggestive way of treating the problem and wonder at the poetic method by which he shows us a space mixed up with elements that represent the three dimensions in separate portions closely interspersed and overlapping one another. We find it difficult to follow him when he says that "the property of space as having three dimensions is only a property of our table of distribution" which is in "the form of a table of triple entry," and is "an internal property of the human intelligence, so to speak."

Poincaré deduces from the definition of space itself "a certain

indeterminateness," and he thinks that it is "precisely this indetermination which constitutes its relativity." Without entering into a discussion of this mooted point it seems to us that the indetermination of space is of Poincaré's own making, while the relativity of space being inherent in the very nature of space is quite independent of it.

P. C.

BOOK REVIEWS AND NOTES.

ESSAYS IN RADICAL EMPIRICISM. By *William James.* Longmans, Green, & Co., New York, 1912. Pp. 282.

Prof. William James was by no means a systematic thinker, and his interests were too various to be satisfied with one interpretation of life. As soon as he had defined one conception he grew beyond himself and longed for a broader view. It is highly characteristic of Professor James that after he had set forth his philosophy of pragmatism, he said in his preface to *The Meaning of Truth* (1909): "I am interested in another doctrine in philosophy to which I give the name of radical empiricism, and it seems to me that the establishment of the pragmatist theory of truth is a step of first-rate importance in making radical empiricism prevail."

The philosophy of "radical empiricism" is outlined in twelve essays collected by Ralph Barton Perry, Professor James's literary executor, in the posthumous publication now before us. The several subjects discussed are as follows: "Does 'Consciousness' Exist?", "A World of Pure Experience," "The Thing and Its Relations," "How Two Minds Can Know One Thing," "The Place of Affectional Facts in a World of Pure Experience," "The Experience of Activity," "The Essence of Humanism," "*La Notion de Conscience,*" "Is Radical Empiricism Solipsistic?", "Mr. Pitkin's Refutation of 'Radical Empiricism,'" "Humanism and Truth Once More," and "Absolutism and Empiricism."

While these articles are written in the same style and with the same breadth of mind as the books on pragmatism, Professor James considers both as independent doctrines. He says: "Let me say that there is no logical connection between pragmatism, as I understand it, and a doctrine which I have recently set forth as 'radical empiricism.' The latter stands on its own feet. One may entirely reject it and still be a pragmatist."

In the editor's preface, Mr. Ralph Barton Perry quotes Professor James as follows: "Let empiricism once become associated with religion, as hitherto through some strange misunderstanding it has been associated with irreligion, and I believe that a new era of religion as well as of philosophy will be ready to begin." K

UNIFICATION AND DEVELOPMENT OF THE PRINCIPLES OF THE ALGEBRA OF SPACE. By *Alexander MacFarlane.* Lancaster, Pa.: New Era Printing Company, 1911. Pp. 92.

This is Dr. MacFarlane's "President's Address" as president of the Inter-

national Association for Promoting Quaternions and Allied Mathematics. He says:

"We have before us the ordinary algebra founded on the straight line, or as Hamilton at one time preferred to say, on pure time. We have next the algebra of the complex quantity, founded on the plane; it is a portion only of plane algebra, for what is treated is the circular part only; the hyperbolic counterpart is almost wholly neglected. For instance, in the solution of the quadratic and the cubic equation, the roots are real and impossible so far as line algebra is concerned, but hyperbolic or circular so far as plane algebra is concerned. This plane algebra is a logical generalization of line algebra, and every theorem in the latter has its generalized form in the former.

"There is a common belief that the algebra of the circular complex quantity rounds off and completes the domain of algebra, and we are furnished with a so-called reduction of every algebraic expression to the form of the circular complex quantity. But that argument is entirely fallacious; for in the plane there is a hyperbolic vector, and none of these can be reduced to the form mentioned. This matter was discussed before the American Institute of Electrical Engineers (*Transactions*, vol. 14, p. 163), the orthodox doctrine being championed by Mr. Steinmetz, and the opposite by myself. My argument was derived from the investigation for the discharge of an electrical condenser; when the discharge is alternating the analysis leads to circular complex quantities and when it is not alternating to hyperbolic complex quantities which are analogous in every particular to the circular.

"Then we have before us three forms of space-analysis: the scalar, founded by Descartes, which makes use of axes, but provides no explicit notation for directed quantities whether line or angle; the quaternionic, founded by Hamilton, which is characterized by a notation for versors or angles in space; the vectorial, founded by Grassmann, which is built on vector-units and compound units derived from them. For the past half century the masters of these several forms have been engaged in a triangular fight; much has been written on vectors *versus* quaternions; and we have heard of a Thirty Years' War between one who could bend the bow of Hamilton and one equally skilled in the weapon of Descartes. It will surely be admitted that each branch contains part of the truth; it is therefore highly probable that none of them contains the whole truth, and that each has a part of the truth which the others have not. It has for long seemed to me that what is wanted is an analysis which will harmonize all three, and present itself as the space-generalization of algebra. As to this conception of the oneness of the algebra of space, I may quote Sylvester's declaration that he would as soon acknowledge a plurality of gods as a plurality of algebras. Likewise, Gibbs at the close of his address to the Mathematics Section of the American Association, said we begin with multiple algebras and end with multiple algebra."

The pamphlet before us contains Professor MacFarlane's solution of the problem which consists mainly in a unification and generalization of the principles of the algebra of space. K

THE UNCAUSED BEING AND THE CRITERION OF TRUTH. By *E. Z. Derr, M. D.* Boston: Sherman, French &. Co., 1911. Pp. 110. Price $1.00 net.

This interesting book takes issue with pragmatism and criticizes Prof.

William James. The author says in the preface: "This work was completed before the death of William James, professor of philosophy in Harvard University, and the criticisms of his pluralistic philosophy stand exactly as then written, without additions or alterations of any kind. As a man, Professor James was beloved by all who knew him, and his benevolent nature and open-mindedness endeared him to many whose philosophical views differed radically from his own. But esteem for the man should not disarm criticism of the writings he has laid before the world. In his last work, *A Pluralistic Universe,* Professor James, in declaring for a finite God, strikes at the very foundation of monotheism. Polytheism, with all its absurdities, is the logical outcome of such a philosophy. Professor James seems to have been so weighed down by the presence of so much suffering in the world that he could not reconcile it with the existence of an Omnipotent Deity."

To Mr. Derr the criterion of truth is the "uncaused being," and here the author may be criticized for the confusion of thought which naturally originates by regarding the uncaused being, whoever that may be, as somewhat beyond the comprehension of man. The very idea is unclear, and yet in his propositions on page 51 Dr. Derr says, "If anything exists an Uncaused Being exists." He adopts the usual agnostic argument based upon the principle that the whole is greater than any of its parts, and concludes from it that the uncaused can not be subjected to analysis or comprehended by that which itself has caused.

While Mr. Derr's positive propositions are open to criticism, his critical comments contain many good observations, among which we call attention to his remarks on the untenability of the current conception of ether as a continuum. He concludes his book on this current hypothesis with his verdict as follows:

"The theory of an ethereal continuum is therefore worthless—worthless by reason of its inconsistency and fundamental incoherence; worthless as absolutely without scientific evidence; worthless as establishing agnosticism between sense perception and *a priori* conceptions; worthless, therefore, in its philosophical implications, for, in predicating absolute infinitude of the ether, it lends itself to that system of thought which identifies the material universe with the ultimate essence of uncaused being."

VOL. XXIII. JULY, 1913. NO. 3.

THE MONIST

CHRISTIAN ELEMENTS IN THE MAHABHARATA, EXCEPTING THE BHAGAVADGITA.[1]

IN the question with regard to the influence Christianity has exerted upon Brahmanism, one of the two great epics, the Râmâyana, is not to be taken into consideration, for it was certainly composed before the Christian era and even its later insertions are not later than the second century after Christ;[2] then too the home of the Râmâyana is in the eastern part of India. The case is different with the Mahâbhârata whose composition extended over at least a millennium. We now know, to be sure, that the Mahâbhârata gradually attained its enormous size for the most part during the period between the fourth century B. C. and the fourth century A. D.,[3] nevertheless it contains not only portions which originated before this period but also single additions of a later date. Georg Bühler's opinion that the Mahâbhârata had attained the final form in which we now have it by the sixth or seventh century is hardly disputed to-day. Accordingly the historical possibility that Christian elements might have entered into our Mahâbhârata text is granted without hesitation; but there is only one

[1] Authorized translation from the German manuscript by Lydia G. Robinson. In the bibliographical references the following abbreviations will be observed: ERE, *Encyclopædia of Religion and Ethics*; IA, *Indian Antiquary*; JAOS, *Journal of the American Oriental Society*; JRAS, *Journal of the Royal Asiatic Society*.

[2] Winternitz, *Geschichte der indischen Litteratur*, I, 427 ff., especially 439, 440.

[3] *Op. cit.*, I, 389 ff.; especially 396, 403.

single portion that can be said with any certain degree of probability to betray acquaintance with Christian doctrines and Christian worship. This is the legend of the Shvetadvîpa, the "White Island," or the "Island (i. e., the land) of the White People" (Mbh. XII, Chapters 337, 338, ed. Calc.).

All competent critics agree that judging from its whole character this passage must belong to the latest interpolations of the great epic. Kennedy[4] places it in the fifth or sixth century; on account of considerations to be given later on I feel compelled to decide in favor of the sixth, and lay stress on the fact that this date which is essential for my explanation of the passage can not be assailed on critical grounds. If this portion really contains an evidence of contact between Brahmanism and Christianity it at the same time provides a proof of the fact that at the time and in the country where the final redaction of the Mahâbhârata took place—in the interior of Northern India —there was as yet no knowledge worth mentioning of the teachings, the worship and the communal life of Christianity; for otherwise this religion would not have seemed so strange and wonderful to the author of the Shvetadvîpa episode.

THE SHVETADVIPA EPISODE.

I must say in advance that not by any means all specialists acknowledge the Christian basis of the Shvetadvîpa legend, but that Barth,[5] Hopkins[6] and others see in it merely an evidence of poetic fancy. I myself formerly advocated this standpoint[7] and have only recently reached

[4] JRAS, 1907, 481.

[5] *Religions de l'Inde*, 132.

[6] *Religions of India*, 431, 432. Nevertheless in *India Old and New*, 161, Hopkins regards as possible a purely external relation with the Christians in Herat or Merv which was brought about by travels.

[7] Translation of the Bhagavadgitâ, Introduction 30.

the conviction that Lassen,[8] Weber,[9] Grierson,[10] Kennedy,[11] etc. are right in finding in this portion the traces of an acquaintance with Christianity.

Briefly stated the content of the legend is as follows: The Mahâbhârata relates in the first of the two chapters under discussion that the wise Nârada has been to Shvetadvîpa and from there has brought back the Pâñcharâtra doctrine proclaimed by the god Nârâyana (which must be discussed later). In the second chapter the three sons of the god Brahma, Ekata, Dvita, and Trita (i. e., Nos. 1, 2, and 3) took the same journey together with the seven Rishis. Shvetadvîpa is more than thirty-two thousand miles (*yojana*) northeast (Mbh., XII, v. 12703) or north (v. 12774) of the mountain Meru on the northern bank of the Milky Sea. The white luminous inhabitants of this land are supernatural beings; they have no sense organs, they live without nourishment, they exhale rare perfumes and are without sin. With their glance they blind the eyes of sinful men and are endowed with other fabulous peculiarities, such as four testicles, sixty normal teeth, and eight fangs (v. 12706). These superhuman beings worship in their hearts the *one* invisible God Nârâyana with softly murmured prayers and hands always folded (v. 12787) and are filled with supreme love for him (v. 12798). None among them occupy exalted positions but all enjoy equal consideration (v. 12790). These latter statements indeed make the impression that they are based upon contact with a Christian community, but I have not been able to discover a description of the eucharist service which Grierson tries to find in this chapter.[12]

[8] *Indische Altertumskunde*, II, 2d ed., 1118-1119.

[9] In many passages; see my translation of the Bhag. Intro. 30 note.

[10] ERE, II, 549*a* and elsewhere.

[11] JRAS, 1907, 481 ff.

[12] Pratâpa Chandra Rây's translation of the Mahâbhârata, Shântiparvan, II, 752 note; Grierson, JRAS, 1907, 316.

The entire legend of Shvetadvîpa is full of unheard-of fancies, behind which however there seems to lurk an actual knowledge of a Christian country. In favor of this view we have, besides these features relating to worship and society which we have just mentioned, the account of the direction (northeast or east) in which Shvetadvîpa is supposed to lie. In spite of this distinct statement Albrecht Weber with almost incomprehensible stubbornness has for decades maintained the assertion that the account of the Mahâbhârata becomes intelligible only when it is recognized to contain traditions of the journeys of pious Indians to Alexandria and the acquaintance with Christianity which they gained there. Because of its location Alexandria cannot of course be considered, and I will not stop to waste words with regard to other utterly foolish localizations. Lassen, who at any rate came nearer to the truth than Weber, probably had Parthia in mind,[13] where some Brahmans may have become acquainted with Christianity and from where they may have brought Christian doctrines to India; but his argument, based on the age of the tradition that St. Thomas had spread the Gospel in this country, will not hold good.

Kennedy has recently made an attempt to determine more exactly the location of Shvetadvîpa.[14] He proceeds from the fact that the statements about its location are too definite for an entirely imaginary country; they could only indicate a land on the other side of the great mountain ranges, Bactria or probably a region lying still farther north, perhaps the banks of Lake Issyk-Kul "where there is an abundance of frozen sea," by which evidently the mythical Milky Sea is to be understood. Kennedy bases the last assumption on the fact that numerous Nestorian communities had dwelt on the southern shore of Issyk-Kul.

[13] Page 3, Note 3.

[14] JRAS, 1907, 482.

But Issyk-Kul can not come into consideration in our attempt to identify the Indian Milky Sea, for the following reasons. In the first place this lake is not so far from India as we would expect from the statements of the Mahâbhârata with regard to the immense distance; in the second place it is not so large as to give the impression of an ocean; and in the third place it never freezes over because of its surprisingly warm water. The Kirghiz name *Issyk-Kul* denotes "warm lake" as does also its Chinese name *She-chaj*. The "abundance of frozen sea" can therefore in no wise suffice to give the lake in winter the appearance of a milky surface.

It seems to me that the more remote Lake Balchash[15] has a much greater claim to identity with the Indian Milky Sea, for to-day it covers about twenty thousand square kilometers or about the same size as the kingdom of Württemberg. *Balchashi Nor* is a Kalmuck expression and means "great water." Various indications go to show that once in earlier times a much larger lake spread over where now Lake Balchash lies.

The idea that Lake Balchash is the Indian Milky Sea becomes intelligible from its Kirghiz name *Ak-Dengis*, "white ocean."[16] This name is scarcely derived from the fact that the lake is covered with ice from the end of November until the beginning of April, but may be accounted for in the following way. Lake Balchash is extraordinarily shallow and, according to the measurements of the Russian geographer L. S. Berg who for the first time examined the lake with some precision in the summer of 1903, it has a maximum depth of only 11 meters. This greatest depth of Berg's measurements is to be found in the western half, and although according to other apparently

[15] My information with regard to this lake I owe to the kindness of my geographical colleagues, Gradmann and Uhlig.

[16] Egli, *Nomina Geographica* (Leipsic, 1872) in the article "Balkaschi Noor."

reliable information there are said to be places in the eastern part as much as twenty meters deep, yet taking the lake on the average, it is not nearly so deep; particularly the southwestern corner and the whole southern bank are extremely low. Berg characterizes the water as muddy,[17] earlier informants call it clear. But this contradiction signifies nothing, for the water of so shallow a fresh-water lake would be stirred by the wind to its very bottom and would *assume a milk-white color*. This, combined with the size and the position of Lake Balchash, makes it correspond excellently with the Indian Milky Sea.

Then when we consider that the most important of the ancient trade-routes of Central Asia led from Samarkand over Tashkent to Kuldsha and Turfan on the south side of Lake Balchash and that the Nestorians had long before sent their missionaries far into Central Asia, then nothing hinders the assumption of Nestorian settlements on Lake Balchash in the sixth century—about a century and a half after the establishment in the year 411 of the Christian church of the Sassanid empire from which such colonies must have proceeded. The land of seven rivers, once famous for its fertility, on the southeast bank of the lake was densely inhabited in earlier times; especially on the Karatal and Ajagus rivers there are said to be many ruins of ancient civilization. The assumption is obvious that in later days these old settlements fell as a sacrifice to the nations of the Steppes or even to the advancing encroachment of the sand.

Prof. Th. Nöldeke wrote me November 6, 1911: "In the region south of Lake Balchash Nestorian communities of some size existed as late as in the thirteenth and fourteenth centuries. We know this from the very numerous gravestones inscribed with Syriac characters and for the most part in the Syriac language—though dreadfully cor-

[17] A. Woeikow in *Petermann's Mitteilungen*, XLIX (1903), 285.

rupted—and partly in Turkish, as the people without doubt spoke Turkish and knew the Syriac only as the language of the church."[18] The two places containing Nestorian churchyards, Pishpek and Tokmak, lie on the slopes of Mt. Alexander quite close to the southern point of Lake Balchash.

That Nestorian communities with a regular clergy existed in these regions at so late a period is evidence at any rate that Nestorians found there in earlier times a flourishing abiding place.

From all I have adduced, the identity of Lake Balchash with the Indian Milky Sea gains at least as much probability as can be attained under the circumstances.[19] Therefore I do not hesitate to state my conviction that Nestorian colonies which originated in the sixth century on the shore of Lake Balchash furnished the foundation for the Shvetadvîpa legend of the Mahâbhârata.

Since Bardesanes,[20] as early as the beginning of the third century, mentions the presence of numerous Brahmans in Bactria, there is no objection to assuming that the account upon which is based the fabulous description of Christian worship and communal life on the banks of the Milky Sea was brought through Bactria to northwestern India. But this information has not been of special significance for the religious life of India, for no new ideas are involved which might have come with it into India. As we shall see later, the idea of divine love and submission to God is traceable in India at a much earlier time. In the story of Shvetadvîpa the author has intended to give only

[18] Chwolson, *Syrische Grabschriften aus Semirjetschie*, Mémoires de l'Ac. Impér. des Sciences de St. Pétersbourg. VII Series, Vol. XXXIV, No. 4, St. Petersburg, 1886, and *Syrisch-nestorianische Grabinschriften aus Semirjetschie*, new series presented to the academy February 28, 1896. St. Petersburg, 1897.

[19] If my identification is correct the older Indian legends of the Milky Sea, especially of its whirling, must be based upon obscure information with regard to Lake Balchash.

[20] In Eusebius, *Praepar. Evang.*, VI, 10 (ed. Gaisford, Vol. II, p. 83, l. 2).

one proof from outside for the doctrine that divine love is the most certain way to supreme salvation. Nor has the Shvetadvîpa story exerted any actual influence on later Indian literature; only in one legend of the Kûrmapurâna, according to which Shiva in the Himalayas had propounded the Yoga system to his four disciples Shveta, Shvetâshva, Shvetashikha and Shvetalohita, and in a very similar story of the Vâyupurâna, can remote echoes of our episode be found.[21] In connection with these legends we can scarcely think with Weber[22] of a Syriac-Christian mission which might have settled in the Himalayas. Still less significant than these legends is the fact that in the modern Krishna and Râma ritual and in the quite late commentary of Svapneshvara to the Shândilyasûtras attention is given to the Shvetadvîpa story.[23] It is a reckless overvaluation when Weber[24] says that there can hardly be any doubt that the worship of Krishna in India to-day is essentially based upon those pilgrimages accounts of which are preserved to us in the Shvetadvîpa story.

THE ATTITUDE OF E. WASHBURN HOPKINS.

I have said above on page 322 that the Shvetadvîpa legend is the only part of the Mahâbhârata in which Christian influence can be assumed with any degree of probability. Hopkins[25] sees a whole series of further possibilities which however do not stand closer inspection, and rest moreover upon the erroneous assumption that Christian missionaries had already been actively engaged in northwestern India ever since the first century. There is no proof of the presence of Christians in India before the first half of the third century.

[21] Lassen, *Indische Altertumskunde*, 2d ed., II, 1119; Wilson, *Selected Works*, III, 148 f.

[22] *Indische Studien*, I, 421, note; II, 398; *Krishnajanmâshtamî*, 322.

[23] Weber, *Krishnajanmâshtamî*, 321.

[24] Ibid. 319, 320.

[25] *India Old and New*, 152 ff.

Although Hopkins prudently emphasizes "how remarkably similar may be *by mere chance* the phraseology of different religions" (p. 150), and although he confirms the warning which lies in these words by bringing forward a number of remarkable parallels between the Veda and the Old Testament,[26] none of which can be suspected on one side or the other of being either source or copy, yet he is not restrained by his own warning from deducing the possibility of a historical connection from the boldest combinations. He is evidently imbued with the desire to find Christian influence in the Mahâbhârata and especially in the Bhagavadgitâ (of which we shall speak in another article) and to have Krishnaism appear dependent upon Christianity at the earliest possible date. To be sure he makes some limitations as we should expect from so thoughtful a scholar, as for instance when on page 159 he "lays no great weight upon parallels which show a possibility of Christian influence," or, on page 160, gives them "for what they are worth." Then too Hopkins is always very careful in his expression when stating the parallels, but nevertheless the whole presentation is calculated to exert a suggestive effect upon the laity and to arouse faith in a far-reaching influence of the New Testament upon the Mahâbhârata. Considering the importance of the subject and the attention which Hopkins's essay has found in wide circles, I am obliged to enter a decided protest against it and therefore may not limit myself to these general observations but must enter more closely into particulars than I would prefer.

BORN OF A VIRGIN.

In Hopkins (page 159) we read: "Krishna is a by-name of Vyasa, the author of the epic (in so far as the arranger of the mass my be called author), who, though

[26] Partly following Kaegi, *Der Rigveda*, 2d ed., 63 ff.

not identified with Krishna as Supreme God, is himself divine, and is described as '*the unborn* (that is, the eternal) *and ancient one, the only son of God, born of a virgin, very part, ança of God.*' He is a figure unknown till the end of the epic, and even his name Vyasas, *vyâsas,* has a certain similarity with *iêsos.*"[27] But *Vyâsa* is a good Indian word and denotes "the arranger." The seer who bears this name is not only looked upon as the arranger of the masses of the Mahâbhârata but of the four Vedas as well and also as the author of the Purânas. Not only the conclusion of the cited passage, where the possibility of the loan of the name is derived from such an accidental and unimportant verbal similarity as can easily be alleged in hundreds of cases from the most different languages, but the whole statement lacks the objectivity and critical acumen to which we are otherwise accustomed in the works of Hopkins. In this opinion, which holds good also for the succeeding comments upon Hopkins, I have in mind mainly the passage I have italicized above, which is intended to make a Christian impression. This quotation Hopkins has pieced together from parts of three different verses of the Mahâbhârata (XII, 13640, 41, 88, ed. Calc.) in order to bring them into accord with Christian ideas! Of course for this purpose the epithet "born of a virgin" is particularly striking. But what is really the case with regard to it? I think I can give the best account of the fantastic story of the birth of Vyâsa in the words of Winternitz:[28]

"He was the son of a famous ascetic, the Rishi Parâshara. One day this great saint saw the maiden Satyavati who had come into the world in a fish and had been reared by fisher folk, and he was so enraptured by her beauty that he besought her love. She would accede to

[27] Of course Ἰησοῦς is meant.

[28] *Geschichte der indischen Litteratur,* I, 268, 269.

his wishes only on condition that after bearing him a son she might again recover her virginity. The holy man granted her this wish as well as that she was to lose her fish odor and to exhale a marvelous fragrance. Directly after their union, she bore him a son upon an island in the Yamunâ and the boy was called Dvaipâyana, 'the island-born.' He grew to manhood and soon devoted himself to a life of asceticism, but Satyavati having resumed her virginity became later the wife of Shântanu, the king of Kuru."

It is for this reason, therefore, that Vyâsa was called the "son of a virgin" (*kânîna*) although his birth was brought about by natural procreation; and yet Hopkins, who was surely acquainted with this story from his intimate acquaintance with the contents of the Mahâbhârata, tried to see in it a parallel to the legend of the supernatural birth of Christ!

THE DIVINE SACRIFICE.

After the sentence here criticized Hopkins continues: "Then of the God Krishna it is said: 'He, the guardian of his flock, the sinless God, the Lord of the world, consented to the death of (himself and) his race that he might fulfil the word of the seers,' where, if we had shepherds and prophets, the comparison would be very striking."

This quotation from the Mahâbhârata (XVI, 161-163; ed. Calc.) deals with the destruction which as a result of a curse of Gândhârî had befallen the Yâdava race whose leader was Krishna. The men fell to quarrelling in a drunken bout and slew each other with clubs; but Krishna himself was mistaken in the forest for an antelope by a hunter with the name Jara, "old age," and was slain by an arrow in his only vulnerable spot on the sole of his foot.[29] The verses quoted by Hopkins, which Vasudeva, the human father of Krishna, speaks, read as follows in a literal

[29] Winternitz, *op. cit.*, I, 317.

translation: "You. . . . recognized Govinda (the winner of herds, i. e., Krishna) as the eternal, sinless, imperishable God; and this my son who was the mighty Vishnu himself (i. e., in whom Vishnu had become incarnate) looked upon the destruction of his own race and permitted it to take place. He, the Lord of the world, desired that the word of Gandhârî and the Rishis should not appear vain, O oppressor of the enemies." Who with unprejudiced judgment could consider Christian influence even possible in this utterance and in the act to which it refers? Hopkins inspires—unconsciously of course—the appearance of such an influence by the suggestive addition "of himself," and by the Christian coloring of the wording of his translation. Krishna did not perish with all his house for the purpose "that he might fulfil the word of the seers," but in order that a genuine Indian curse might be fulfilled as occurs in Brahman narrative literature with annoying frequency.

THE UTTERMOST PARTS OF THE SEA.

Hopkins continues: "Another passage. . ., close to biblical phraseology, may be found in the description of the avenging spirits: 'If thou goest into the depths of the earth, or if thou shouldst fly above, or if thou fleest to the further sidè of the sea, still thou shalt find no escape from them' (Mhb. IV, 428); as compared with the psalmist's words, 'Whither shall I fly. . . . into heaven. . . . Sheol. . . . the uttermost parts of the sea?' (Ps. cxxxix. 7 ff.)."

Might not this passage in the Psalms equally well be compared with the verse, many centuries older, in the famous Varuna hymn of Atharvaveda (4, 16, 4): "Whosoever were to flee far away from heaven, could not escape from Varuna the king," and would we not have to see in this parallel a new warning against the attempt to found

a loan hypothesis upon such similarities of expression?[30] Here too we must not consider the verse of the Mahâbhârata apart from the situation to which it is related. Kîchaka wishes to seduce Draupadî, but she rejects him and threatens him with the revenge of her five husbands who are Gandharvas. And now just imagine how the poet in describing *this* situation could have had in mind a verse of the Psalms and have depended on that whereas throughout the whole context of these stories not a single trace of biblical influence can be found! To the possible objection that we should consider that such biblical phrases had already been adopted at this time in Brahman India, and might have been used even without remembering their source, it may be answered that, apart from the great intrinsic improbability, the extraordinary scarcity of really striking parallels in the Mahâbhârata argues against it. There is not the slightest reason to question the Indian originality of such passages.

The next quotation, "Thou seest the faults of others, though they be no larger than mustard, but thine own faults thou canst not see though they be as large as a bilva tree" (Mbh., I, 3069) indicates only such a uniformity of *thought* with the familiar passage in the Bible, as can be accounted for on general considerations, but not the characteristic figure of the moat and beam in the eye.

THE SAINT ON THE STAKE.

Hopkins then brings forward at the end of the paragraph a very singular parallel: "Even the crucifixion has its analogy in the story of the Stake-Saint (impaling being the equivalent of crucifixion), who was unjustly impaled with thieves, but he did not die like the thieves and so awakened the wonder of the royal guard. They went and told the king, who was frightened when he heard of it

[30] See above, page 329.

and came to the Saint on the Stake and besought his forgiveness, which was granted as the king had acted ignorantly. He is besung in all the worlds as the Impaled One.... It is perhaps not impossible that there is here the echo of Christian story." On the contrary it is quite impossible and entirely excluded. It is only necessary to examine more closely the story in the Mahâbhârata (I, Chaps. 107, 108) in order to find that the only similarity to the crucifixion of Christ consists in the fact that it is an innocent man who is executed. This has happened often enough on earth, and has proved an effectual theme for narrative in the literature of all nations. In our case even the manner of death is not the same.

The Indian story is as follows: For many years Mândavya, the anchorite, has sat in front of his hermitage with upraised arms observing the vow of silence. One day robbers pursued by the police come running up and hide their booty in the hermitage, concealing themselves near by. The pursuers ask the hermit which way the robbers fled and of course receive no answer from him. Soon they catch the thieves and find the booty in Mândavya's hermitage, whereupon he is suspected of complicity with the robbers, is brought before the king, and sentenced to death. The executioners impale Mândavya, but he still continues to live by virtue of his asceticism although he receives no food, and by this same virtue he summons other saints who come at night in the form of birds and sorrowfully ask him for what guilt he is obliged to suffer the martyrdom of impaling. Mândavya answers: "Upon whom shall I lay the blame? No one else (but myself) brings this upon me." The king receives the information that Mândavya keeps alive in some miraculous way, and hastens to beg his pardon and to have the stake of martyrdom taken down. But when he tries to draw the stake from the body of the hermit he is not successful, and therefore cuts it

off at the surface of the body. Mândavya goes away bearing in his body the point of the stake during the rest of his life, and continues to practise his efficacious asceticism. But from that time on he was known throughout the entire world as Anî Mândavya, "Mândavya with the peg." One day he betook himself to the abode of Dharma, the god of justice, and asked the deity seated upon his heavenly throne for what unwittingly committed sin he now had to endure such horrible suffering. Dharma told him that the punishment was because once when he was a child he had pierced insects in the back with a reed. Thereupon Mândavya cursed the god that he should be born again as a Shûdra, because he had inflicted so disproportionately severe a punishment for a childish misdemeanor. The curse was of course fulfilled.

Is not the genuinely Indian impression of this fantastic tale most obvious? Can we conceive of a larger number of characteristically Indian features than the type of the hermit, the supernatural power of his asceticism which performs impossible miracles and in the face of which the gods themselves are powerless, the idea of unfailing retaliation for every deed and the inevitable curse at the end? How can a scholar otherwise so clear sighted, who comes to the conclusion that there is no historical connection in the hundred times greater similarity of New Testament narratives with their *Buddhist* parallels consider it even possible to find in the story just related an echo of the account of the passion of Christ?[31] It becomes psychologically comprehensible only through a religious temperament which is instinctively impelled to discover transmissions from Christianity. Who seeks such reasons for Christian influence on the Mahâbhârata gives the best

[31] In his *Religions of India*, p. 432, Hopkins has wisely declared this idea impossible: "It is not of course due to Christian influence that the great 'saint of the stake' is taken by the 'king's men,' is crucified (or literally impaled) among thieves, and lives so long that the guard go and tell the king of the miracle."

evidence by this very fact that such influence does not exist.

THE ORIGIN OF KRISHNAISM.

From these details I turn to a question of more general significance, namely the problem of the origin of Krishnaism, of which the oldest continuous source is the Mahâbhârata. What we learn from the great epic with regard to the development of this religion and the connection in which it belongs is briefly as follows:

In the war between the Kauravas and the Pândavas, which forms the kernel of the Mahâbhârata, Krishna, the scion of the Sâtvata branch of the Yâdava tribe and the leader of this small nomadic people, stands as friend and helper on the side of the Pândavas. The conjecture that the figure of Krishna is derived from a non-Aryan nation because the name denotes "black" or "dark" and because Krishna is represented in art as a man of a dark blue color,[1] is untenable, for not only the name "Krishna" but also the names of his parents and of his wife are good Aryan names.

In the oldest portions of the epic Krishna is nothing but a human—yes and all too human—person: for the Pândavas to win destroy their enemies in honorable battle but by cunning and treachery, and it is always Krishna who instigates and defends the treachery. This to be sure may find its explanation in the fact that the Mahâbhârata was originally a poem in honor of the Kauravas which attached to the friend of the Pândavas the stigma of a tricky and deceitful man, and that it was worked over at a later time into a Pândava epic in which of course the ally of its heroes must be glorified. But still it is remarkable that these features of deceit and treachery were not eradicated from the character of Krishna in recasting the

[1] L. D. Barnett, *Bhagavadgîtâ translated*, Introduction, p. 7; J. Kennedy, 1907, p. 61.

ancient epic; for this proves that at the time when the revision took place Krishna still lived in the memory of the people as a thoroughly human personality.

I will treat later on of the probable motive of the exaltation of Krishna into the sphere of the superhuman, but first I shall give only the facts as far as we have use for them here.

From the leader of a half-savage nomadic tribe Krishna became first a demigod and then the tribal deity of the Yâdavas—a process to which an analogy in modern India may be brought forward in the exaltation of the Marâtha chief Shivaji to divine dignity.[33]

The descendants of the victorious Pândavas were glad to accept the new god who had promoted the advancement of their forefathers and bestowed great care upon the

[33] Hopkins, *India Old and New*, 105, in the essay, "A Study of Gods." In the very same passage Hopkins explains Krishna and Râma to be "originally local chieftains of northern India." His conviction of the originally human nature of Krishna could not be more definitely stated. But farther on in the book where it might be expected, i. e., in the chapter "Christ in India," Hopkins makes no use of this conviction in his treatment of Krishna and Krishnaism. The essay just mentioned, "A Study of Gods," was first published in 1899, and hence was written about the same time as his work *Religions of India* (1898), in which Hopkins on pages 467 and 468 calls Krishna an anthropomorphized god. We are surprised to read this, for a few pages earlier (page 465) Hopkins claims a historical character for Krishna and rightly identifies him "with the character mentioned in the Chândôgya Upanishad, 3, 17, 6," i. e., with a human disciple. It is evident that Hopkins's views with regard to Krishna have changed, and not only in the course of time, but mutually contradictory views are presented at the same time in the same work, yes even within a few pages.

In note 31 I have already mentioned one case in which Hopkins has replaced an earlier correct view at a later time by an incorrect one. Since he does this in silence we must assume that the earlier exposition has escaped his memory to the detriment of the subject in hand. Exactly the same thing may be observed of another passage. In *Religions of India*, page 429, Hopkins says that "the teaching of Christianity certainly may be suspected, but it can not be shown to exist in the Divine Song" (the Bhagavadgitâ) and on page 430 he declares the Christian influence on this text to be "doubtful to the last degree." Three years later in *India Old and New* (pp. 152 ff.) he expresses himself—without reference to his former view—on the ground of a number of parallels which on closer consideration prove nothing under the circumstances, very decisively *in favor of* the dependence of the Bhagavadgitâ on the doctrines of Christianity: "They [the parallels] present a body of evidence that is, I think, almost conclusive in favor of one of the religions having borrowed from the other" (p. 155), which according to the context can only mean borrowing from Christianity. Cf. also page 158 where the Fourth Gospel is called "peculiarly suitable to influence the Hindu divines." In this case too the Hopkins of 1898 is to be preferred to the Hopkins of 1901.

worship of the powerful and popular figure. To the Brahmans, who at first could not have approved this god who was avowedly a patron of warriors, and was originally the tribal deity of un-Brahmanized nomads, nothing remained but to make friends with the new cult if they wished to extend their influence to the worshipers of Krishna. They could do nothing better than, by making use of the convenient theory of incarnation, explain Krishna as an incarnation (*avatâra*) of the god Vishnu.[34]

That this occurred at the latest in the fourth century B. C. has been contested, to be sure, by Kennedy;[35] nevertheless it certainly follows from the well-known fact that Megasthenes, who lived as the ambassador of Seleukos Nikator at the court of Pâtaliputra from 302 to 288 B. C., unmistakably recognizes Krishna in his accounts as an avatâra of Vishnu under the name Heracles by the side of Dionysos (= Shiva).[36]

In the later portions of the Mahâbhârata Krishna's exaltation has made greater progress, for there he appears as the All-God, as one with the world-soul, the Brahman.

How genuinely Indian was this entire development we recognize from the fact that it is demonstrated in exactly

[34] Cf. Grierson, ERE, II, 541*b*: "The incorporation was carried out in exactly the same way as that in which we see Brahmaism extending its frontiers at the present day. The process is going on now before our eyes. Local or aboriginal deities are discovered to be identical with Shiva or some other member of the Brahmanical pantheon, and the distinction of caste is conferred upon the converts. Usually they are declared to be Râjputs, or, in other words, of the Kshatriya class. The aboriginal customs and beliefs are at first left untouched, and in a couple of generations no more ardent supporters of the claims of the Brâhmanical priesthood are to be found than those who are still fetish-ridden savages."

[35] That his reasons (JRAS, 1907, 962 ff.) prove nothing, has been shown by A. Berriedale Keith (*vid.*, 1908, 170 ff.). Kennedy's reply to this (505 ff.) has not changed the situation.

[36] Lassen, *Indische Altertumskunde*, II, 2d ed., 1107, 1226. Nârâyana and Vâsudeva (two by-names of Krishna) and Vishnu have already been identified in Taittiriya Aranyake, X, 1, 6; i. e., in a passage which belongs at the latest to the third century B. C. but is probably still older. Cf. Weber, *Ind. Stud.*, XIII, 353, Note 1; A. Berriedale Keith, JRAS, 1908, 171, Note 2. J. Kennedy in JRAS, 1907, 974, places the identification of Krishna and Vishnu not earlier than in the time of Kâlidâsa, that is to say, in the fifth or sixth century *after*

+1

the same way in a second instance, namely in the hero of the Râmâyana, Râmâ, who originally was also purely human, and who likewise became transformed first into a demigod and finally into the All-God and who like Krishna was regarded as an incarnation of Vishnu. Although the euhemeristic conception has otherwise seldom proved true in the realm of the history of religion, yet in India from earliest antiquity down to the present time, it has often proved to be correct. Not only heroes and founders of sects but also a large number of poets and authors on non-religious subjects have been identified with gods or simply deified in India.[37]

It has therefore never seemed quite intelligible to me that many such scholars as Tiele, Senart, Barth, Kennedy, A. Berriedale Keith—really also A. Weber and Hopkins in the greater part of his utterances—could in spite of the clear evidence of our sources, have described Krishna as originally a purely mythical figure, as a sun-god or a vegetation spirit. Against this conception speak the human character of Krishna in the oldest parts of the Mahâbhârata and the entire development traceable throughout the great epic. Then too the humanization of a primitive deity which these scholars accept in agreement with Indian mythology, would have succeeded too well with the Indian poets to be credible. Krishna is not a humanized god but a deified man, and mythology has reversed the actual relation, as has also been done to be sure in other instances in the transformation myths.

It is easy enough to understand that later when Krishna had become the most popular divinity of the Indian pantheon and his worshipers related more and more wonderful stories about him, all sorts of features entered

[37] H. Jacobi at the close of his paper, "Kultur-, Sprach- und Literarhistorisches aus dem Kautiliya," *Sitzungsberichte der K. Preussischen Akademie der Wissenschaften*, 1911 (XLIV), 973; Hopkins, *Religions of India*, 522, note, after JA, XI, 56, 149.

into his cycle of myths and legends which originally belonged to the ancient sun-god and other deities. The transference of solar myths upon Krishna was a necessary consequence of his identification with Vishnu who was primarily a solar god. Grierson[38] places a rather high value, though without adducing this reason, on the influence of the solar cult, but in other respects takes throughout the standpoint here presented. Moreover, local divinities may also have been entirely fused with Krishna and have been absorbed in him.[39] This seems to be verified by the fact that Dvârakâ, the capital of the mature hero Krishna, is on the west coast of Gujerat, whereas all the legends referring to his childhood and youth are laid in the interior of the country towards Mathurâ on the Yamunâ (near the present Agra) and their vicinity. Of course we may draw no *basis* for an explanation from all such *later additions* to the cycle of Krishna legends.

That of all the heroes of the Mahâbhârata Krishna alone has been exalted in so remarkable a manner is hardly due to an incalculable chance, but must have had a particular cause. In the Mahâbhârata there is no lack of chieftains and successful warriors who would have been equally well or better suited for deification. For the explanation of the distinction of Krishna, R. G. Bhandarker, the most eminent Sanskritist among the natives of India, has proposed a conjecture[40] in whose favor much may be said, and which has later been verified by others with further proofs.[41]

[38] In his important article "Bhaktimârga," ERE, II, 540, *b*.

[39] J. Kennedy, JRAS, 1907, 960 ff., with whose confused mythological speculations, however, I in no wise agree.

[40] In two places consistently: (1) In his *Report on the search for Sanskrit Manuscripts in the Bombay Presidency during the year 1883-84*, Bombay, 1887, p. 74; and (2) In the essay, "The Râmanujiya and the Bhâgarata or Pâncharâtra Systems" in the *Verhandlungen des VII. Internationalen Orientalisten-Kongresses, Arische Sektion*, Vienna, 1888, pp. 101 ff., especially 107 ff. Cf. also G. Bühler, JA, 1894, 248.

[41] Introduction to my translation of the Bhagavadgîtâ, 19 ff.; Grierson,

According to this view Krishna, the son of Vasudeva and Devaki, was not only a tribal chieftain but also the founder of a religion which first gained a footing among the Yâdavas but soon spread beyond the boundaries of the tribal community and became of immense importance in the evolution of religious life in India. This religion is the originally un-Brahmanic *monotheistic religion* independent of Vedic tradition whose adherents were called Bhâgavatas and later Pâñcharâtras and who worshiped the supreme Being under the epithets Bhagavat, "the Exalted One,"[42] and Purusottama, "the supreme spirit." When the founder of this religion was deified in Indian fashion he became identified with the god he had proclaimed; and so Krishna, his patronymic Vâsudeva, "son of Vâsudeva," and Nârâyana, "son of man," came to be other names of this god. The result then of the later Brahmanization of the sect, as we have said before, was that Krishna was also made one form of the god Vishnu.

The Bhâgavata religion from which according to this conception Krishnaism arose, was primarily a popular Kshatriya religion and probably preached the doctrine of divine love from the beginning and emphasized the ethical side to a much stronger degree than Brahmanism, especially the requirement to do one's duty. In proof of this many passages from the Mahâbhârata may be adduced.[43]

The point of departure from the assumption that Krishna was the founder of this religion is furnished by a passage of the old Chândôgya Upanishad (3, 17, 6) in which Krishna, "the son of Devaki," is mentioned as the pupil of a famous sage, the Angirasid Ghora, in connection with doctrines which bear a pronounced ethical character, namely asceticism, liberality, uprightness, doing no one

JRAS, 1908, 603 ff.; "The Nârâyaniya and the Bhâgavatas," IA, 1908, 251 ff., especially 253; "Bhakti-mârga," ERE, II, 539 ff. and elsewhere.

[42] From this is derived *Bhâgavata*, "worshiper of the Bhagavat."

[43] Introduction to my translation of the Bhagavadgîtâ, 24.

harm and speaking the truth (v. 4)—these requirements are to take the place of the sacrificial fee due to the priests, and the sacrifice itself is to be represented in the kind of life to be led.

If we bear in mind at the same time the fact that Krishna is the son of Devakî also in the Mahâbhârata, and appears in its older portions as warrior, councilor, and *promulgator of religious doctrines,* then the identity of the personalities can not be questioned and the character of Krishna as a religious teacher is as well corroborated as can be expected from the nature of the sources. The religion proclaimed by Krishna in the Mahâbhârata is precisely the Bhâgavata religion, and its chief text-book is the Bhagavadgîtâ, the "Song of the Exalted One," (i. e., of Krishna, who is revealed in it as the All-God) the most famous episode of the Mahâbhârata.

The entire conception here submitted gains in probability from the fact that Krishna's patronymic Vâsudeva as the designation of a god, is authenticated by Bhandarkar especially in the tribe to which Krishna, according to all tradition, belongs.

The Chândôgya Upanishad in which Krishna is mentioned dates from pre-Buddhistic times, and since there must surely be a historical basis for the war between the Kauravas and Pândavas, described in the Mahâbhârata, in which Krishna took part, the period of Krishna's life must be set considerably earlier than that of Buddha. Indian mythology places the incarnation of Vishnu as Krishna in the interval between the ages of Dvâpara and Kali, i. e., before the beginning of the present eon.[44] As early as the sixth century before Christ the Krishna cult must have flourished in its fullest bloom, because the ruins of the temple discovered in December, 1896, by Führer at Rummindêi on the southeastern border of Nepal, bear

[44] Lassen, *Indische Altertumskunde,* II, 2d ed., 1128, Note 4.

witness that the ancestors of Buddha worshiped among other objects of their devotion Krishna's favorite wife, Rukmini.[45] The local name Rummindêi is the vernacular corruption of Rukmini devi, "the goddess Rukminî."

At any rate Krishna belonged to an age in which the Kshatriyas had a more important share in the promotion of the spiritual life of India than the Brahmans, who in those centuries squandered their strength mainly in the development of the sacrificial system and in speculations on the significance of the sacrifices, until they were seized by the loftier ideas which proceeded from the Kshatriya caste and were aroused to more worthy manifestation of their abilities. Krishna, the founder of a theistic religion, probably preceded by some centuries the atheistic founders Buddha and Mahâvîra, the originator of the Jaina sect; but all three were Kshatriyas, as were also the founders of the monistic doctrine of the Brahman-Atman, according to the evidence of the older Uponishads.[46]

I was obliged thus far to discuss these preliminary points about Krishna and the origin of Krishnaism in order to be able to approach the most important question in this chapter.

THE CHILD KRISHNA.

That Christian elements entered into the *later* phases of Krishnaism is undeniable and will not be contradicted by any Indologue. This will be further discussed later on. But there is lack of unanimity as to the time from which the Christian influence must be assumed, especially whether it is to be already found in the later parts of the

[45] Karl Eugen Neumann in the introductory preface to A. Paul, *Krischnas Weltengang*, Munich, 1905, 6, 7. When Neumann at the conclusion of this preface says "that all essential and many of the unessential parts of the legend of Krishna are derived from the epoch of the ancient Vedic hymns," a statement is made, without any attempt at proof, which is contradicted by the entire character of the Krishna legend. Not in any case does it extend back to the ancient Vedic period.

[46] See my *Beiträge zur indischen Kulturgeschichte*, Berlin, 1903, 1 ff.

Mahâbhârata serving to glorify Krishna. J. Kennedy, one of the champions in favor of the affirmative, in harmony with earlier expositions of Wilson and Weber, speaks of a complete change in the conception of Krishna.[47] He says that until about 500 A. D. Krishna was a thoroughly warlike god, a destroyer of giants and dragons; but that then his character suddenly and completely changed: that all at once he became an idyllic pastoral god, a child growing up to young manhood and also a god of love; that the Krishna *child* especially threw the older Krishna and other deities in the shade and everywhere made victorious headway. This last observation is correct and verifies a fact whose significance for the history of religion is greatly underestimated by Oldenberg when he asks[48] what ultimate significance the idyll of the Krishna child has for Hinduism. In a later essay[49] Kennedy explains this alleged sudden change by the assumption that about that time Scythian (i. e., Central Asiatic) nomads brought the "child-god" from the north to Mathurâ and with him a Christian legend and a Christian festival.

This entire theory fails under critical investigation. The sudden change in the conception of Krishna was really a very gradual transformation the beginnings of which take us back to a very much earlier time than Kennedy supposes. Since this scholar places particular weight upon the significance of Krishna as a child, I will first take up this point in detail.

The earliest connected narrative of Krishna's birth and childhood[50] is to be found in the Harivamsha, "the genealogy of Hari, i. e., of Vishnu," an appendix to the

[47] JRAS. 1907. 486.

[48] *Indien und die Religionswissenschaft*. 20.

[49] "The child Krishna, Christianity, and the Gujars," JRAS. 1907. 951-992, especially 976, 981 ff., 989. Similarly also Hopkins in *India Old and New*, 162.

[50] Two subordinate features are briefly mentioned in Mbh., II, 1439, 40, acknowledged to be a late interpolation.

Mahâbhârata which as early as the fifth century A. D. was considered a component part of the great epic[51] and can not have been written essentially earlier. The Harivamsha in its second part—which is the greatest and most important of its three divisions—treats of Vishnu incarnated as Krishna, but not of the ally of the Pândavas and the promulgator of religious doctrines as does the Mahâbhârata proper; rather does it offer a legendary biography of Krishna from his birth together with all the heroic deeds, adventures and love stories which we find also in the later Purana literature. Especially the fifth book of the Vishnupurâna[52] and the tenth of the Bhâgavatapurâna which indeed is much more extensive, agree pretty well in substance with the Krishna part (Vishnuparvan) of the Harivamsha.

I shall give only the beginning of this biography of Krishna, which has special importance for us, as told in Winternitz's summary,[53] and sum up the rest in a few words.

"In the city of Mathurâ there reigned a wicked king Kamsa. Nârada told him that he would meet death at the hands of the eighth son of Devakî, the sister of his father and the wife of Vasudeva. Thereupon Kamsa determined to slay all the children of Devakî. He had his servants keep a strict watch on Devakî, and six of her children were put to death as soon as they were born. The seventh child—who was that brother of Krishna later known as "Râma with the ploughshare," "Balarâma" or "Baladeva"—was rescued by Nidrâ, the goddess of sleep, who took the child from his mother before his birth and transferred him to Rohinî, another of Vasudeva's wives. But the eighth son,

[51] Winternitz, *Geschichte der indischen Litteratur*, I, 395.

[52] Translated into German by A. Paul, *Krischnas Weltengang*, Munich, 1905.

[53] *Op. cit.*, I, 381.

who was Krishna, Vasudeva himself, in order to save him from Kamsa, exchanged as soon as he was born for the daughter who had been born at the same time to the shepherd folk, Nanda and Yashodâ. So the shepherd's daughter was hurled against a rock by Kamsa while Krishna was thought to be the son of a shepherd and grew up among the herdsmen. To the guardianship of the herdsman's family, Vasudeva entrusted Râma also, and the two boys grew up together as herdsmen."

While yet an infant Krishna gave evidence of his superhuman power, and when a boy performed miraculous and heroic deeds which caused him to be considered the special guardian of pastoral life. For instance he overcame a terrible snake-demon in the Yamunâ and compelled him with all his train to withdraw into the ocean; and during a frightful storm he held a mountain as a protection over the shepherds and their flocks for seven days so that they remained uninjured. Although the shepherds wished because of these deeds to worship him as a god, he preferred to pursue his life among them simply as their friend and kinsman. Now for the first time are described his nocturnal revels, frolics and dances with the shepherd girls who are all in love with him and sing of his heroic deeds.

Of all these deeds in which Krishna overcomes a vast number of men and demons and once even the god of death in the lower world, we need mention here only one, the revenge he took on his wicked uncle Kamsa. In his residence at Mathurâ, this king heard of the deeds of valor of the two young herdsmen Krishna and Râma, and because he was afraid of them he concluded to put them out of the way by strategy. He invited them to his capital to a festival and a contest with two of his strongest wrestlers. The two young heroes came and killed the powerful wrestlers, and when King Kamsa in his wrath commanded the victors to be driven from the country, Krishna laid hold of

the king, drew him on to the place of combat and killed him.

In the beginning of this legendary biography of Krishna, Kennedy sees, as others have seen before him, an imitation of Christian prototypes. The slaughter of Vasudeva's children is thought to have been copied from the slaughter of the innocents at Bethlehem, and the early life of Krishna in a shepherd community from the birth of Christ among the shepherds. The agreements in the two parallels are certainly not so remarkable as to make at first sight the dependence of these features of the Krishna legend upon the New Testament narratives very probable. Still in this case we do not need to establish our position upon such general considerations but are so fortunate as to be able to prove positively the incorrectness of the loan hypothesis.

In Patañjali's Mahâbhâshya, the great commentary on the grammar of Panini which was written in the middle of the second century B. C., we find several examples of Krishna's hostile relation to his uncle Kamsa: "Krishna was hostile to his uncle" (2, 3, 36), "Vâsudeva, as everybody knows, slew Kamsa" (3, 2, 111), and in 3, 1, 26, the *Kamsavadha,* "the slaying of Kamsa," and the *Balibandha,* "the capture of the demon Bali," that is to say, two well-known acts of Krishna, or Vishnu, are mentioned as familiar material for rhapsodies, dramatic presentations and paintings.[54] That enmity existed between Krishna and his uncle Kamsa and that the latter had met his death at the hands of his nephew, were accordingly features of the Krishna legend knowledge of which could be assumed to be general at the time of the Mahâbhâshya. This requires a further line of argument. The features of the legend we have given represent at any rate such a remarkable di-

[54] A. Weber, *Ind. Stud.*, 13, 353 ff., 488 ff.; A. Berriedale Keith, JRAS, 1908, 172 ff.

vergence from the usual state of things between near relatives, that where a story was in circulation in which the nephew is the foe of his uncle and slays him, the cause of this abnormal relation must also have been a part of the story. Whoever was acquainted with these features must also have been familiar with the attempts of the uncle to put out of the way the nephew whom he feared. Whence it follows that at the time of the Mahâbhâshya those circumstances too were already generally known which according to the narrative of the Harivamsha had taken place before, at and after the birth of Krishna, and that especially the story of the slaughter of Vasudeva's children is older than the story of the slaughter of the innocents at Bethlehem.

Accordingly in the second century before Christ, not only the powerful hero Krishna, but even the Krishna child already played a significant rôle in Brahman India, and indeed the *divine child* since (as we have seen above, pages 338 and 342) Krishna had been worshiped as God as early as the sixth century B. C. in Buddha's native land,[55] and his identification with Vishnu was established by the fourth century B. C.

The divine child Krishna accordingly does not appear in India suddenly about 500 A. D. as Kennedy tells us, but was known there at least 700 years earlier, and indeed in his particular relation to pastoral life. Therefore his veneration is of genuinely Indian origin.

Hence it would not be necessary to examine critically Kennedy's assumption that it was the Gujars (Sanskrit, *Gurjara*) who brought the worship of the Christchild from Central Asia to Mathurâ about 500 A. D. But the absolute untenability of the theory just refuted becomes even

[55] The Brahmanic Hindus who emigrated to the western part of further India in the second century A. D. were also worshipers of Vâsudeva; and the same is to be assumed of those who settled on the island Madura near Java. Lassen, *Indische Altertumskunde*, II, 2d ed., 1112.

clearer when we recognize that the speculations upon which Kennedy found his standpoint hang entirely in midair. We are not clear either with regard to the ethnological position nor the original home of the Gujars, who first appear in the northwest part of the Punjab in the middle of the sixth century A. D. and later extend farther south especially over the peninsula named for them Gujarât. Nor have we any account that the Gujars—and indeed as early as about 500 A. D.—reached the region of Mathurâ; nothing that we know about them speaks in favor of this. But before all else we shall ask whether the Gujars were Christians or were so imbued with Christian conceptions that we may assume that through their influence the Krishna legend was transformed in the Christian meaning. And would the Brahmanic Indians in Mathurâ, who belonged to a much higher grade of civilization, have been very ready to accept instruction from a crude race of immigrant nomads? As an answer to the first question we find Kennedy[56] suggesting the hypothesis that the Gujars "*might have* acquired some tincture of Christianity, either from their neighbors in Central Asia or from their connection with Christians among the Hûnas." For the Gujars are mentioned in connection with the Huns and probably penetrated into India together with them.[57] Somewhat farther down Kennedy says (p. 990): "Probably the nomads who brought the new god to Mathurâ knew little of Christianity except the stories of the Infancy." Hence men who knew so little of Christianity, and possibly not even that, who according to Kennedy at best—"might have" shows how insecure Kennedy feels the basis of his reasoning to be—had come only into the most external contact with Christianity, are supposed to have had sufficient interest in it to carry the doctrine of the Christchild to other nations!

[56] JRAS, 1907, 989.

[57] Hoernle and Stark, *History of India*, 61.

To spread religious teachings among foreign people and those of another faith usually requires a zeal enkindled by the strongest conviction.

But enough! It may be maintained with absolute certainty that Christianity, the Gujars, and the date 500 A. D. have nothing to do with the appearance of the Krishnachild in the religious life of India. The appearance of Christian features in the legends of Krishna's birth and childhood and in the Krishna cult did not take place at the earliest until two centuries later and must be placed to the account of the Nestorian missions.

As with the beginning of the Krishna legend the case is the same with another of its features which is referred by Hopkins to a Christian prototype in a way entirely incomprehensible to me.[58] I refer to the flirtations of Krishna with the shepherdesses in which Hopkins sees a reflection of "eternal Christianity" which he declares to be as "palpable" as it is "shocking." What in Christianity is meant spiritually is, according to Hopkins, interpreted in India physically and carnally. "The love of the Bridegroom is sensual; the brides of God are drunken dancing girls."

The truth is we have the same development on both sides. Sensual love which is celebrated in the Old Testament marriage songs of Canticles is raised to a spiritual sense by Christian symbolism when it is made to represent the longing of the human soul for the Saviour under the image of the bridal relation. In like manner in India the much celebrated love of the shepherdesses for Krishna later became spiritualized and was given a new meaning in the sense of the ardent love of man for the deity.

It would be too strange for a legend relating the life of Krishna among the shepherds to have contained nothing of the love and admiration felt by the rustic maidens for the hero and of his love affairs with them; for in the

[58] *Religions of India*, 430.

popular view all heroes of extraordinary strength are inexhaustible in the enjoyment of love, and in spite of all renunciation of the world and asceticism, the erotic element plays a much larger part in the life of the highly sensually organized Hindus than in the Occident. Therefore this feature of the Krishna legend has not originated by the adoption and degradation of a Christian idea, but it is genuinely Indian and is precisely demanded by the situation; moreover it is older then the entrance of Christian influences into Brahman India. For even though Krishna's flirtations are treated in poetic form for the first time in the Harivamsha[59] yet their conception dates from a much earlier time. As early as in the Mahâbhârata (2,2291) Krishna is addressed by Draupadî as the "lover of the shepherdesses" (*Gopîjanapriya*) in a passage belonging to one of the older portions of the great epic, where there can be no question of the possibility of a Christian influence which in the opinion of Hopkins is supposed to be "obvious."

There now remain for our consideration only two more features of Krishnaism which are found as early as in the Mahâbhârata and whose derivation from Christianity has been not infrequently asserted or surmised. These are the conception of Krishna as the god who loves mankind and the requirement to render to Krishna a believing love. These two features appear most distinctly in the Bhagavadgîtâ, the most splendid portion of the Mahâbhârata, and they have found there their most significant expression. Since the Bhagavadgîtâ on account of its unique position in India which has been maintained down to the present day, and on account of its many parallels with the New Testament, requires a separate investigation, the divine love which this song celebrates in its twofold sense

[59] This is done later most extensively in the tenth book of Bhâgavatapurâna, and in an esthetically complete fashion in Jayadeva's *Gitagovinda.*

can not be explained as a mi
and we have as yet no mea
by a mechanical interaction
the mechanistic principle as
cause speculation can disc
cesses of any kind than as
cooperation of parts. Un
obliged to assume that th
portions of which, howev
best microscopes to make
fied with the belief that u
least we know nothing to
destroy our hope that th
could not ultimately be ex

La Mettrie is uncon
a common occurrence t
the necessity of limitin
carried away by *a prio*
on experience alone, a
naturalists of this type
laws suffer no exceptio
it can never be proved
ing universality it is
La Mettrie is no exc
dences of the interco
may be, can not car
the fact stated, i. e.,
their identity.

"Man is so co
a clear idea of the
fine it. For this re
the greatest philos
far as they use, a
a posteriori or b
of the body, so
concerning man'
certainty what

"Let us th
no heed to the
be blind and
kind of blind

ROBERT HOOKE AS A PRECURSOR OF NEWTON.

MACH[1] has emphasized that in estimating the achievements of Newton in the theory of gravitation we should not underrate that of the imagination. "We have, indeed," says Mach, "no hesitation in saying that this last is the most important of all." In the present article, I wish to point out the fact that the way for this feat of imagination was amply prepared, notably by Robert Hooke, whose works can hardly have been quite unknown—directly or indirectly— to Newton.

The ideas that the key to the motions of the sun and planets was a gravitational force and that the orbits could be explained by a force deflecting the planets from the straight line which, according to Galileo's law of inertia, they would otherwise describe uniformly, were quite familiar to Newton's elder contemporaries Wren, Hooke and Halley. What made it impossible for them, and possible for Newton, to unlock the door which guarded one of the secrets of the heavens was simply due to the happy circumstances that Newton was a great and far-seeing mathematician, and the time was ripe for the reduction of infinitesimal ideas into a powerful method. The "method of fluxions" was, we know, discovered by Newton even before the falling apple, according to the well-known story, first turned his thoughts toward gravitation.

Newton's feat of imagination consisted[2] in the widen-

[1] *Mechanics*, p. 189.
[2] *Ibid.*, p. 190.

ing of his sphere of thought so as to connect the falling of the moon in her orbit towards the earth with the descent of a stone near the surface of the earth. Newton[3] himself illustrated the identity of terrestrial gravity with the universal gravitation which determines the motions of the celestial bodies by imagining stones to be projected from the top of a high mountain with greater and greater horizontal velocities. Finally the stones become satellites circulating round the earth. Later, commenting on Rosenberger's[4] statement that the idea of universal gravitation did not originate with Newton, Mach[5] says: "But it may be safely asserted that it was with all of them a question of conjecture, of a groping and imperfect grasp of the problem, and that no one before Newton grappled with the notion so comprehensively and energetically; so that above and beyond the great mathematical problem, which Rosenberger concedes, there still remains to Newton the credit of a colossal feat of the imagination." Mach[6] then gave a short account of some of Hooke's researches, and concluded: "Thus Hooke really approached nearest to Newton's conception, though he never completely reached the latter's altitude of view."

It seems to me that we must lay less stress on Newton's feat of imagination and more stress on his great advance in mathematics and its applications to physics than Mach, apparently, would admit. Further, and this seems to me the most important thing from a philosophical point of view, we shall see that Hooke had begun to grasp that principle of mechanics which Newton grasped more firmly in his third "Law of Motion."

In quotations from old works, I shall, since my object

[3] *Ibid.*, pp. 533-534.

[4] *Isaac Newton und seine physikalischen Principien*, Leipsic, 1895, pp. 135-157.

[5] *Mechanics*, p. 531.

[6] *Ibid.*, p. 532.

is scientific and not merely literary, modernize spelling and punctuation. However I shall always quote literally for purposes of reference the *titles* of books and such passages as seem to have a literary interest.

I.

Robert Hooke was born at Freshwater in the Isle of Wight on July 18, 1635. He was very infirm and weakly and was therefore nursed at home, though his brothers and sisters were nursed abroad, and for at least seven years his parents had very little hope of his life, since he was often ill. For his age he was very sprightly and active in running, leaping, and so on, though very weak as to any robust exercise. He was very quick to learn anything, and, after his English, soon learned his Grammar by heart but, as he says, with little understanding, till his father, who was minister of the parish of Freshwater, designing him for the ministry, took some pains to instruct him. But since he was very often subject to the headaches which hindered his learning, his father laid aside all thoughts of breeding him a scholar, and finding that he himself grew very infirm through age and sickness, he wholly neglected his son's further education. Thus Hooke being left to himself spent his time in making little mechanical toys about which he was very intent. He endeavored to imitate everything he saw done by any mechanic; he had also a great fancy for drawing. How he spent the next six or seven years of his life is not known. After his father's death in 1648, he was placed in the workshop of Sir Peter Lely the painter, but presumably stayed there only a short time as the smell of the oil colors did not agree with his constitution. After this he lived with Dr. Busby, master of Westminster School, with whom his education progressed with surprising rapidity both in its classical and mathematical branches. Here he applied himself to Latin

and Greek and at the same time made some acquaintance with Hebrew and other Oriental languages. Here too he began a serious study of mathematics. From Westminster School he went in 1653 to Christ Church, Oxford, as "servitor" (one who performed certain menial duties instead of paying fees) and ten years later he took his M.A. degree by special recommendation of Lord Clarendon, then Chancellor of the university. After 1655 he was employed and patronized by the famous experimental physicist (the Hon.) Robert Boyle,[7] who turned Hooke's skill to account in the construction of his celebrated air-pump. Hooke's inventive faculty exercised itself between 1657 and 1659 in devising thirty different methods of flying, and also—more profitably—in regulating the movements of watches by the application of the balance spring. In 1675 a lively controversy arose between him and Huygens respecting their rival claims to this ingenious invention. The truth seems to be that the original idea belonged to Hooke, but that the coiled form of the spring, on which its practical utility depends, was due to Huygens. On November 12, 1662, Hooke was appointed first curator of Experiments to the Royal Society,[8] and filled the office with extraordinary diligence and skill during the remainder of his life. In 1664 Sir John Cutler instituted for Hooke's benefit a mechanical lectureship of £50 a year, and in the following year he was nominated Professor of Geometry in Gresham College, London, where he subsequently resided. After the great fire in 1666 he constructed a model for the rebuilding of the city, which was highly approved although the design of Wren was preferred. Neither plan was, however, adopted. During the progress of the works Hooke acted as surveyor, and accumulated in that lucrative employment a sum of several thousand pounds. This hoard was dis-

[7] See Mach, *Mechanics*, pp. 123-127.

[8] This society was founded in 1662. Cf. Rosenberger, *op. cit.*, pp. 69-71.

covered after his death in an old iron chest which had evidently lain unopened for about thirty years. He fulfilled the duties of secretary to the Royal Society during five years after the death of Henry Oldenburg in 1677.

A protracted controversy with Hevelius, in which Hooke urged the advantages of telescopic over plain sights, brought him little but discredit. His reasons were good but his offensive style of argument rendered them unpalatable and himself unpopular. Many circumstances concurred to embitter the latter years of his life. The death in 1687 of his niece, Mrs. Grace Hooke, who had lived with him for many years, caused him deep affliction; a lawsuit with Sir John Cutler about his salary—a suit which was, however, decided in his favor in 1696—occasioned him prolonged anxiety; and the repeated anticipation of his discoveries inspired him with a morbid jealousy. Marks of public respect were not wanting to him. A degree of M.D. was conferred on him at Doctor's Commons, December 7, 1691, and in 1696 the Royal Society made him a grant to enable him to complete his scientific inventions. While engaged on this task he died, worn out with disease and toil, on March 3, 1703, and was buried in St. Helen's Church, Bishopsgate Street.

In personal appearance Hooke made but a poor show. His figure was crooked and his limbs shrunken; his hair hung in disheveled locks over his haggard countenance. His temper was irritable, his habits penurious and solitary. He was blameless in morals, and reverent in religion. His scientific performances would probably have been more striking if they had been less varied. He originated much, but perfected little. His optical investigations led him to adopt in an imperfect form the undulatory theory of light, to anticipate the doctrine of interference, and to observe independently of, though subsequently to, Grimaldi the phenomenon of diffraction. He was the first to state clearly

that the motion of heavenly bodies must be regarded as a mechanical problem, and he approached in a remarkable manner the discovery of universal gravitation. He suggested a method of meteorological forecasting and a system of telescopic signaling, anticipated Chladni's experiment of strewing a vibrating bell with flour, investigated the nature of sounds and the function of the air in respiration and combustion, and originated the idea of using the pendulum as a measure of gravity.[9]

His principal writings are *Micrographia or some Physiological Descriptions of Minute Bodies* (London, 1665, 1667),[10] *Lectiones Cutlerianae* (London, 1679), and *Posthumous Works*, containing a sketch of his "Philosophical Algebra," published by Richard Waller in 1705. A biography of Hooke was prefixed by Waller to the *Posthumous Works of Robert Hooke*.[11] This prefixture, entitled "The Life of Dr. Robert Hooke,"[12] which, by the way, has been referred to by Brewster[13] as if it were a separate publication and which utilized the beginning of an autobiography left by Hooke, gave, in Waller's words, "An Account of his Studies and Employments, with an Enumeration of the many Experiments, Instruments, Contrivances and Inventions, by him made and produced as Curator of Experiments to the *Royal Society*." This biography, together with that in the ninth edition of the *Encyclopaedia Britannica*, has been used in what precedes.

Hooke was a very ingenious man and a skilful experimenter. Here we are only concerned with his speculations

[9] Cf. also W. W. Rouse Ball, *A Short Account of the History of Mathematics*, 4th. ed., London, 1908, p. 315. Cf. also Rosenberger, *op. cit.* pp. 71-73.

[10] Rosenberger, *op. cit.*, p. 35.

[11] *The Posthumous Works of Robert Hooke... Containing his Cutlerian Lectures and other Discourses Read at the Meetings of the Illustrious Royal Society. In which.....* published by Richard Waller, London, 1705.

[12] *Ibid.*, pp. i-xxviii.

[13] *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, Edinburgh, 1855, Vol. I, pp. 285, 286; 2d. ed., 1860, Vol. I, p. 249.

on gravitation and his relations with Newton on this point. The biographical details into which we have entered are very much to the point when we are considering Hooke's work on the theory of gravitation. Hooke's education, owing to his health and worldly circumstances, was incomplete. Owing to these reasons and his ill fortune with his inventions and writings, he was jealous and embittered. His speculations show that he was, I think, quite the equal of Newton in imagination. As a mathematician he was vastly inferior to Newton, and hence his merits have been less noticed than they deserve to be, since they lie in the shadow of the great theory which was almost completed by Newton with unrivaled mathematical talent. And lastly, Newton himself seems to have underestimated the value of Hooke's work and perhaps even its influence on himself. Both in his researches on the theory of gravitation and in his discovery of the method of fluxions, Newton showed at first an almost complete lack of interest in his rights of authorship, and later, when a question of whether others had plagiarized from him arose, he showed himself touchy, suspicious, ready to attribute meannesses to others, and ready to expend great labor in the carrying out of a mean action. An example of this last unenviable characteristic is given by the discovery, after Newton's death, of a first draft in Newton's own handwriting of an account—in Newton's favor—of the dispute between Newton and Leibniz and their supporters about the invention of the infinitesimal calculus. This document was intended to appear as, and was indeed printed as, the unbiassed report of a committee of independent judges appointed by the Royal Society.

Newton's amanuensis has left on record how Newton, with apparent carelessness, used to leave a box of guineas lying about in his rooms at Trinity College, Cambridge. The amanuensis thinks it possible that this was done to

test the honesty of the old woman who made his bed and cleaned his rooms. It is difficult not to be forced to think that we see some analogy between his scientific and his domestic methods. If we resist this temptation, we shall have to assume that in early life Newton was either not conscious of the importance for science of his discoveries or even did not esteem science itself very highly, but that in later life his sense of property grew so strong that it embraced even things for which he did not care. I do not think that it can be maintained that Newton, at any rate until he was old, did not really esteem science highly. He wrote[14] indeed to Hooke in 1678 that he "had for some years past been endeavoring to bend" himself "from philosophy to other studies in so much," said he, "that I have long grudged the time spent in that study unless it be perhaps at idle hours sometimes for a diversion," and[15] that his "affection for philosophy" was "worn out, so that," as he said, "I am almost as little concerned about it as one tradesman uses to be about another man's trade or a country man about learning"; and[16] to Halley in 1686 that "Philosophy is such an impertinently litigious Lady that a man had as good be engaged in lawsuits as have to do with her. I found it so formerly, and now I am no sooner come near her again, but she gives me warning." Still, Newton fortunately did not then abandon "philosophy." He hated and was irritated by controversy, but in spite of this he only abandoned the science which gave rise to the controversies he suffered so impatiently when he was honored and prosperous and when nobody in England had the presumption to set up an opinion against that of the great and god-like Newton.

Nor could Newton have been under the delusion that

[14] W. W. Rouse Ball, *An Essay on Newton's Principia*, London, 1893, p. 141; cf. pp. 155, 157.

[15] *Ibid.*, p. 44.

[16] *Ibid.*, pp. 158-159.

his discoveries were of little moment to science. So we must, I think, infer that his character changed from the frankness shown in his first printed researches on optics[17] to the secretiveness and grudgingness to others shown in the manner in which the *Principia* was written, and in the jealousy, lack of candor and suspicion shown to all but his most intimate friends. This change was brought about, it seems, by the partly irritating controversies—the criticisms and objections of Hooke, Huygens, Pardies, Linus, Gascoigne, Lucas[18]—to which his early optical researches gave rise.

We will now turn to Hooke's publications. It seems true that, as Rosenberger[19] says: "Since Hooke, like Borelli, was a very clever physicist but no mathematician, he too could only be the percursor of a greater discoverer in whose brightness the lesser sun of his fame faded from view more than it should."

II.

As an indirect result of an inquiry into the nature of gravity instituted by the Royal Society in 1661,[20] Hooke on March 21, 1666, according to Birch,[21] "presented a paper, which was read, containing some experiments of gravity made in a deep well near Banstead Downs in Surrey; to which was annexed the scheme of an instrument for finding the difference of the weight, if any, between a body placed on the surface of the earth, or at a considerable

[17] Cf. Rosenberger, *op. cit.*, pp. 67-68.

[18] *Ibid.*, pp. 73-117.

[19] *Ibid.*, pp. 150-151.

[20] *Ibid.*, p. 151.

[21] Thomas Birch: *The History of the Royal Society of London for improving of Natural Knowledge, from its first rise. In which the most considerable of those Papers communicated to the Society which have hitherto not been published, are inserted in their proper order, as a Supplement to the Philosophical Transactions*, Vol. II, London, 1756, pp. 69-72; the extract is from pp. 69-70. Cf. pp. 77-78.

distance from it, either upwards or downwards. It was ordered that this paper should be registered[22] as follows:

" 'Gravity, though it seems to be one of the most universal active principles in the world, and consequently ought to be the most considerable, yet has it had the ill fate to have been always, till of late, esteemed otherwise, even to slighting and neglect. But the inquisitiveness of this later age has begun to find sufficient arguments to entertain other thoughts of it. Gilbert began to imagine it a magnetical attractive power inherent in the parts of the terrestrial globe; the noble Verulam [Francis Bacon] also, in part, embraced this opinion; and Kepler (not without good reason) makes it a property inherent in all celestial bodies,—sun, stars, planets. This supposition we may afterwards more particularly examine; but first it will be requisite to consider whether this gravitating or attracting power be inherent in the parts of the earth, and, if so, whether it be magnetical, electrical, or of some other nature distinct from either.

" 'First then, if it be magnetical, any body attracted by it ought to gravitate more, when nearer to its surface, than when farther off.' "

The ingenious experiments, which were conducted at the tops of Westminster Abbey and St. Paul's Cathedral, led, however, to no result.[23]

III.

On May 23, 1666, according to the Journal Book of the Royal Society,[24] there was read "a paper of Mr. Hooke's concerning the inflection of a direct motion into a curve by a supervening attractive principle," which was ordered

[22] Register, Vol. III, p. 93.

[23] Rosenberger, *op. cit.*, pp. 151-152; Mach, *Mechanics*, p. 532.

[24] Waller, *loc. cit.*, p. xii; Birch, *op. cit.*, pp. 90-92; Rouse Ball, *Essay*, p. 151.

to be registered.[25] "The discourse contained therein," says Waller, quoting Hooke, "is an introduction to an experiment to show that circular motion is compounded of an endeavor by a direct motion by the tangent and of another endeavor tending to the center."

This paper is as follows:[26]

"I have often wondered why the planets should move about the sun according to Copernicus's supposition, being not included in any solid orbs (which the ancients possibly for this reason might embrace) nor tied to it, as their center, by any visible strings; and neither depart from it beyond such a degree, nor yet move in a straight line as all bodies that have but one single impulse ought to do. For a solid body, moved in a fluid towards any part—unless it be protruded aside by some near impulse, or be impeded in that motion by some other obviating body, or that the medium through which it is moved be supposed not equally penetrable every way—must persevere in its motion in a right line, and neither deflect this way nor that way from it. But all celestial bodies, being regular solid bodies, and moved in a fluid and yet moved in circular or elliptical lines and not straight, must have some other cause besides the first impressed impulse that must bend their motion into that curve. And for the performance of this effect I cannot imagine any other likely cause besides these two: The first may be from an unequal density of the medium through which the planetary body is to be moved. That is, if we suppose that part of the medium which is farthest from the center, or sun, to be more dense outward than that which is more near, it will follow that the direct motion will be always deflected inwards by the easiest yielding of the inward and the greater resistance of the outward part of that medium. This has some probabilities attend-

[25] Register, Vol. III, p. 114.

[26] Birch, *op. cit.*, pp. 90-91.

ing it: thus, that if the ether be somewhat of the nature of the air, it is rational that that part which is nearer the sun, the fountain of heat, should be most rarified, and consequently that those which are most remote should be most dense; but there are other improbabilities that attend this supposition which, being nothing to my present purpose, I shall omit.

" 'But the second cause of inflecting a direct motion into a curve may be from an attractive property of the body placed in the center whereby it continually endeavors to attract or draw it to itself. For if such a principle be supposed, all the phenomena of the planets seem possible to be explained by the common principle of mechanical motions, and possibly the prosecuting this speculation may give us a true hypothesis of their motion, and from some few observations their motions may be so far brought to a certainty that we may be able to calculate them to the greatest exactness and certainty that can be desired.' "

Hooke illustrated the motions of the planets about the sun by means of an experiment with a conical pendulum.[27] The force to the center, in this case, increases with the distance, which is not so with the attraction of the sun. The experiment was thus merely superficially imitative and not explanatory, and the most interesting thing was a second pendulum-experiment which imitated the motion of the moon. Hooke added a smaller ball which he made to swing round the first by means of a short string that was fastened to the wire; he then remarked "that neither the bigger ball which represented the earth nor the less which represented the moon were moved in so perfect a circle or ellipsis as that in which they would otherwise have moved if either of them had been suspended and moved singly,

[27] Cf. Waller, *loc. cit.*, p. xii; Birch, *op. cit.*, pp. 91-92; Brewster, *op. cit.*, Vol. I, pp. 283-286; 2d ed., pp. 247-249; Rosenberger, *op. cit.*, pp. 152-153; S. P. Rigaud, *Historical Essay on the first Publication of Sir Isaac Newton's Principia*, Oxford, 1838, pp. 38-40.

but that a certain point, which seemed to be the center of gravity of these two bodies, however posited[28] (considered as one), seemed to be regularly moved in such a circle or ellipsis, the two balls having other peculiar motions in small epicycles about the same point."

"This last observation reminds us," says Rigaud, "of the fundamental property of motion in the eleventh section of the first book of the *Principia*; but that was much more than Hooke could have demonstrated, and indeed his experiment, though it answered the immediate purpose of illustrating his hypothesis, admitted no further reasoning to be derived from it as to the motion of the planets. He was aware that it did not represent the true action of gravitation, because the tendency towards the middle (there was no fixed point to which the body was constantly drawn) increased with the horizontal distance, which he knew to be wrong, although he gave no indication at the time of his knowing what the law really was by which the variation of gravity was regulated."

The eleventh section of the first book of the *Principia* is on the motions of bodies under their mutual attractions, and here, for the first time in the *Principia,* is applied the third law of motion—or rather that (fourth) corollary from it known as the principle of the conservation of the center of gravity. Hooke's name is not mentioned in connection with the third law in Newton's scholium, but here and, as we shall see, elsewhere, Hooke made quite perceptible advances towards both this law and the Newtonian conception of "mass." In neither case did he bring his thoughts into the form of a definite enunciation, but he may, I think, be considered as occupying in this respect a position intermediate between Descartes and Newton.

The instinctive nature of the third law may also be illus-

[28] Brewster has here the misprint "pointed."

trated by an extract from Birch's *History*[29] which immediately follows the account of Hooke's paper just referred to:

"Mr. Oldenburg produced a letter written to him by Dr. Wallis from Oxford, May 19, 1666,[30] in answer to the objections made at the preceding meeting against his hypothesis of the tides. This letter giving occasion to renew the discourse upon that subject, Dr. Goddard offered to the consideration of the Society this doubt, viz., supposing the earth and moon to move about a compound center of gravity, if the highest tides be at new moon when the earth is farthest from, and the moon nearest to the sun, and the tides abate as the earth approaches nearer till she comes into the supposed circle of her annual motion; why they do not abate, as the earth comes still nearer to the sun within the said circle? And so why we have not one spring-tide and one neap-tide in every course of the moon?"

Let us return to Hooke's idea—an idea which is a consequence of Galileo's considerations and was shared by Wren and Halley[31]—of compounding the planetary motions of a direct tangential motion and an attractive motion towards the central body. Hooke in a letter to Newton of 1679[32] asked for Newton's thoughts on this idea. Newton in his answer said[33] that so far as he remembered he had not before heard of this "hypothesis." Hooke, judging from his manuscript comments on this letter,[34] did not believe this statement. There seems no reason to doubt Newton's word; we know that such ideas were not peculiar to Hooke alone, and further, building on the dynamics of

[29] Vol. II, p. 93.

[30] Letter-Book, Vol. I, p. 320: It is printed in the *Phil. Trans.*, No. 16, pp. 281-283, end of the 2d section.

[31] Rouse Ball, *Essay*, p. 162.

[32] *Ibid.*, p. 140.

[33] *Ibid.*, p. 141.

[34] *Ibid.*, pp. 144-145, 152.

Galileo, Newton was surely quite capable of extricating and applying such an idea.

IV.

In March, 1671,[35] Hooke "showed several experiments to explain the nature and cause of gravity: particularly, on the 9th, an experiment was made in which some flour put into a void shallow glass with a large sloping brim and a pretty tall foot was made to rise and run over like a fluid, by the knocking on the edge of the glass, and also by the forcibly moving of one's finger round the edge of the same. Leaden bullets also being put into this glass, did, by knocking, move it like a fluid. . . . This was proposed to consider what might be the cause of gravity and suggest an hypothesis to explicate the motion of gravity by. . . ."

V.

Later Hooke resumed the consideration of the subject of the planetary motions, and in a work which appeared in 1674[36] he published some interesting observations on gravity. "I shall hereafter," he says,[37] "explain a system of the world, differing in many particulars from any yet known but answering in all things to the common rules of mechanical motions. This depends upon three suppositions. First, that all celestial bodies whatsoever have an attraction or gravitating power towards their own centers whereby they attract not only their own parts and keep them from flying from them, as we may observe the earth to do, but that they also do attract all the other celestial bodies that are within the sphere of their activity; and consequently that not only the sun and moon have an in-

[35] Waller, *loc. cit.*, pp. xiv-xv.

[36] *An attempt to prove the Annual Motion of the Earth, from Observations made by Robert Hooke*, London, 1674; Cf.. *Phil. Trans.*, No. 101, p. 12. Cf. also Brewster, *op. cit.*, Vol. I, pp. 286-288, 2d ed., Vol. I, pp. 249-251; Rosenberger, *op. cit.*, pp. 153-155; Rouse Ball, *Essay*, pp. 151-152.

[37] At the end, pp. 27-28.

fluence upon the body and motion of the earth, and the earth upon them, but that Mercury and also Venus, Mars, Jupiter, and Saturn, by their attractive powers, have a considerable influence upon its motion, as in the same manner the corresponding attractive power of the earth has a considerable influence upon every one of their motions also. The second supposition is this, that all bodies whatsoever that are put into a direct and simple motion will so continue to move forward in a straight line till they are, by some other effectual powers, deflected and bent into a motion describing a circle, ellipsis, or some other more compounded curve line. The third supposition is that these attractive powers are so much the more powerful in operating, by how much the nearer the body wrought upon is to their own centers. Now what these several degrees are I have not yet experimentally verified; but it is a notion which, if fully prosecuted as it ought to be, will mightily assist the astronomer to reduce all the celestial motions to a certain rule, which I doubt will never be done true without it. He that understands the nature of the circular pendulum and of circular motion will easily understand the whole ground of this principle, and will know where to find direction in nature for the true stating thereof. This I only hint at present to such as have ability and opportunity of prosecuting this inquiry and are not wanting of industry for observing and calculating, wishing heartily such may be found, having myself many other things in hand which I would first complete, and therefore cannot so well attend it. But this I durst promise the undertaker, that he will find all the great motions of the world to be influenced by this principle, and that the true understanding thereof will be the true perfection of astronomy."[38]

[38] In quoting this passage, which Delambre (*Astronomie du 18me Siècle*, pp. 9, 10) admits to be very curious, he scarcely does justice to Hooke when he says that what it contains is found expressly in Kepler. It is quite true that Kepler mentioned as probable the law of squares of the distances, but he afterwards, as Delambre admits, rejected it for that of the simple dis-

"In this remarkable passage," says Brewster, "the doctrine of universal gravitation and the general law of the planetary motions are clearly laid down. The diminution of gravity as the square of the distance is alone wanting to complete the basis of the Newtonian philosophy, but even this desideratum was in the course of a few years supplied by Dr. Hooke." We will speak of this in the seventh section.

VI.

In Hooke's *Cometa* of 1678, he speaks not only distinctly of a "kind of gravitation by which the planets are attracted and have a tendency towards the sun as terrestrial bodies have towards the center of the earth,"[39] but considers comets as probably acted upon by the same force and moving by the effect of it in curvilinear paths.[40]

VII.

Hooke, after Oldenburg's death, became secretary of the Royal Society, and accordingly wrote a friendly letter on November 24, 1679,[41] to Newton, expressing a hope that he would continue to make communications to the Society, and, among other things, asking Newton to communicate to him any objection he might have to Hooke's idea of compounding tangential and central motions, referred to in the third section above. Newton, in his reply of November 28, excused himself from the proposed correspondence on the grounds of a cessation of his interest in "philosophy," but he courteously discussed some of the

tances. Hooke, on the contrary, announces it as a truth. Clairaut has justly remarked that the example of Hooke and Kepler shows how great is the difference between a truth conjectured or asserted and a truth demonstrated. This note is Brewster's.

[39] P. 31.

[40] P. 44. Cf. Rigaud, *op. cit.*, p. 38, and Rouse Ball, *Essay*, p. 157.

[41] Most of the letters, or drafts of them, together with Hooke's comments, in this correspondence between Hooke and Newton are in the Library of Trinity College, Cambridge, and are printed in Rouse Ball's *Essay*, pp. 138-153; cf. pp. 18-24. Cf. also Rosenberger, *op. cit.*, pp. 155, 167-171.

topics suggested by Hooke, and mentioned that it had occurred to him that a demonstration of the earth's diurnal rotation might be obtained by seeing whether a stone. when falling freely, deviated in an easterly direction from the perpendicular, and added that the free path was part of a spiral which passed through the earth's center. The question simply concerned the composition of the motion of the stone round the earth's axis with its falling motion.[42]

This letter was read to the Society on December 4, 1679; and to this reading refer Waller's[43] words:

"An experiment being suggested to try whether the earth moved with a diurnal motion or not, by the fall of a body from a considerable height, alleging it would fall to the east of true perpendicular, Mr. Hooke read a discourse upon that subject, wherein he explained what the line described by a falling body must be, supposing it to be moved circularly by the diurnal motion of the earth, and perpendicularly by the power of gravity, and showed it would not be a spiral line, but an excentrical-elliptoid, supposing no resistance in the medium, but supposing a resistance, it would be an excentric-ellipti-spiral, which after many revolutions, would rest in the center at last; that the fall of the body would not be directly east but to the south-east, and more to the south than the east. This was tried, in which the ball was still found to fall to the south-east."[44]

On December 9, Hooke wrote again to Newton;[45] the letter is lost, but it seems to have been to the same effect as the communication to the Royal Society. Newton's reply is missing, but Newton wrote to Halley in 1686 that Hooke's "letters occasioned my finding the method of determining figures" described under a central force and

[42] Birch, *History*, Vol. III, 1757, pp. 512-513; Rouse Ball, *Essay*, p. 145.
[43] *Loc. cit.*, p. xxii.
[44] Cf. Birch, *History*, Vol. III, p. 516; Rouse Ball, *Essay*, p. 146.
[45] Rouse Ball, *Essay*, pp. 145, 152.

finding thus the ellipse,[46] and "his correcting my spiral occasioned my finding the theorem by which I afterwards examined the ellipsis."[47]

It must be added that in Hooke's letter of January 6, 1680,[48] the law of attraction (varying as the inverse square of the distance) is explicitly stated,[49] and Newton, in the scholium to the fourth proposition of the second section of the first book of the *Principia,* gave Hooke credit for this.

These are the facts on which was based the controversy between Hooke and Newton about the discovery of the theory of gravitation. We shall here pass over this controversy, and in the next section will give some account of Hooke's fundamental physical views, among which is the beginning of a conception of "mass" as distinct from the Cartesian idea of a plenum of matter whose essence is extension. Hooke considered an ether containing pieces of matter, apparently qualitatively different.

However, we must here give some account of a rather pathetic incident which occurred as a result of the controversy between Hooke and Newton about the discovery of the theory of gravitation.

In 1813, says Rigaud,* a collection of letters was printed from the originals in the Bodleian Library of Oxford, with some biographical notices taken from the manuscripts of J. Aubrey in the Ashmolean Museum of Oxford. Among these last was a letter from Aubrey to A. Wood on the claims of Hooke to the discoveries which were said to pass for Newton's. Aubrey's own authority on such a point is not great, and the letter therefore, as it is printed,

[46] *Ibid.,* p. 165.

[47] *Ibid.,* p. 167.

[48] It must be remembered that at that time in England the year began on March 25, so that this date was then January 6, 1679.

[49] Rouse Ball, Essay, p. 147.

* *Op. cit.,* pp. 41-42.

is not only obscure, but deprived of its real value. The editor has given a long passage which he states to be taken from what is in Hooke's handwriting; but he has inserted it in the wrong place, in such a manner as to make it appear to be merely a loose paper which Aubrey had sent to his correspondent. By a reference however to the the original, it was found that the letter must have been written under Hooke's immediate direction; it is not only corrected and altered by him in many places, but by far the greater part consists of additions which he has made with his own hand. This letter is reproduced by Rigaud.* As Rigaud's work is rather rare we will here reproduce the letter of Aubrey and Hooke spoken of.

"Sept. 15, 1689.

"Mr. Wood!

"Mr. Rob. Hooke, R.S.S., did in anno 1670 write a discourse called, An Attempt to prove the Motion of the Earth, which he then read to the Royal Society; but printed it in the beginning of the year 1674....† to Sir John Cutler, to whom it is dedicated, wherein he has delivered the theory of explaining the celestial motions mechanically; his words are these, pag. 27, 28. viz.‡

"About 9 or 10 years ago Mr. Hooke writ to Mr. Isaac Newton of Trin. Coll. Cambridge, to make a demonstration of [it] *this Theory, not* telling him *at first* the proportion of the gravity to the distance, [and] *nor what was* the curved line that was thereby made.

"Mr. Newton [did express], in his answer to the letter, *did* express that he had not thought§ of it; and in his first

* *Ibid.*, pp. 52-55 of Appendices. In the following letter, whatever was inserted by Hooke is in italics. Aubrey's words are enclosed in square brackets when they have been erased in order that others might be substituted for them.

† The words here are not legible, but probably they make mention of Hooke "as lecturer to Sir John Cutler," or something to that purport.

‡ Here a space is left in which Aubrey evidently intended to insert the passage.

§ "known" is written over "thought"; but the first word is not erased.

attempt about it, he calculated the curve by supposing the attraction to be the same at all distances: upon which Mr. Hooke told him in his next letter the whole of his Hypothesis, scil. that the gravitation was reciprocal to the square of the distance, *which would make the motion in an ellipsis, in one of whose foci the sun being placed, the aphelion and perihelion of the planet would be opposite to each other in the same line, which is the whole celestial theory, concerning which Mr. Newton hath made a demonstration,* not at all owning he received the first intimation of it from Mr. Hooke. Likewise Mr. Newton has in the same book printed some other theories and experiments of Mr. Hooke's *as that* about the oval figure of the earth and sea, without acknowledging from whom he had [it] *them, though he had not sent it up with the other parts of his book, till near a month after this theory was read to the Society by R. H.,* (Mr. Hooke,) *when it served to help to answer Dr. Wallis his arguments produced in the R. S. against it.*

"In the Attempt to prove the Motion of the Earth, etc., printed 1674, but read to the Royal Society 1671, pag. 27, lin. 31.

" 'I shall only for the present hint, that I have, in some of my foregoing observations, discovered some new motions even in the earth itself, which perhaps were not dreamt of before, which I shall hereafter more at large describe, when further trials have more fully confirmed and completed these beginnings. .At which time also I shall explain a system of the world. But these degrees and proportions of the power of attraction in the celestial bodies and motions were communicated to Mr. Newton by R. Hooke in the year 1678 by letters, as will plainly appear both by the copies of the said letters, and the letters of Mr. Newton in answer to them, which are both in the custody*

* Here follows the extract already reproduced in § V above down to "experimentally verified."

*of the said R. H., both which also were read before the Royal Society at their public meeting, as appears by the Journal Book of the said Society.'**

"Mr. Wood!

"This is the greatest discovery in nature, that ever was since the world's creation: it never was so much as hinted by any man before. I know you will do him right. I hope you may read his hand: I wish he had writ plainer, and afforded a little more paper.

Tuus,

"J. AUBREY. . . .

"Before I leave this town I will get of him a catalogue of what he hath wrote, and as much of his inventions as I can; but they are many hundreds; he believes not fewer than a thousand. 'Tis such a hard matter to get people to do themselves right."

Other letters† in the Bodleian, of which Rigaud's extracts are given here, show that Hooke had been incessantly urging Aubrey to procure some notice of him by Wood. Thus:

"London, Sept. 15, 1674. Mr. Hooke told me, (who has looked over your book‡), that you have left out several eminent men. You have not either mentioned him, which I desired. England has hardly produced a greater wit, viz. for mechanics."

"Gresham Coll., March 2, 1691-2. Mr. Wood! I acquainted you, some weeks since, that Mr. Hooke (now Dr. Hooke) desired you to do him the favor to send him a transcript of what you are to print concerning him. I have not yet heard from you about it: and Dr. Hooke doth again

* In the Journal Book of the Royal Society there is no mention of any such correspondence in 1678, or in 1679 till December. It was a mistake therefore in Hooke to refer to the former of these two years.

From this point the quotation, *"But it is a notion. . . .the true perfection of astronomy,"* is resumed.

† *Ibid.*, pp. 56-57 of Appendices.

‡ *Historia et Antiquitates Univers. Oxon.*; published in 1674.

this day earnestly desire you would be pleased to write as aforesaid, as soon as you can possibly: for it doth (he says) exceedingly concern him. He will repay you for the transcription, which I shall deliver to you when I come to you."

"London, March 3, 1691-2. Mr. Wood! I sent you a letter some weeks since that Dr. Hooke remembers him very kindly to you, and does earnestly request you to do him the favour to send him a transcript of what you intend to write of him, with all possible speed; and he will repay you for the transcribing. To this purpose I yesterday left a letter with Mr. Bennet; but to-day speaking with Mr. Bennet, he tells me that he sent a letter from you to me, by the penny-post, on Saturday last: my landlady affirms she received it not. Now your book* drawing to an end, I, not knowing what the consequence of that letter may be, thought it a sure way to trouble [you] with this letter by the post."

"April 13, 1692, Gresham College. Dr. Hooke does again desire, if you do make any mention concerning him, you would favour him with a copy of it, before it goes to the press, and he will gratify you in anything that is equivalent. He remembers him kindly to you, and will be ready to serve you in any thing that may lie in his way."

VIII.

To "A Discourse of the Nature of Comets; read at the Meetings of the Royal Society soon after *Michaelmas*, 1682," in Hooke's *Posthumous Works*,[50] "we have.... here annexed," says Waller,[51] "a pretty large, and (if I may be allowed to speak) an ingenious discourse of gravity or gravitation. The running title will direct the reader to it. In this he considers the most known properties of

* *Athenae Oxonienses*, of which the first edition was completed and published in 1692.

[50] *Posthumous Works*, pp. 149-185; cf. Rosenberger, *op. cit.*, pp. 156-157.

[51] *Posthumous Works*, pp. 149-150.

the celestial bodies, and having made several deductions from observations, as to the nature of the ether, air, and the like, in which *in transitu* he explains thunder and lightning, asserting a levitation, as well as gravitation (or a receding from, as well as tendency towards the center); having also shown that the ether or vast fluid *expansum* is the medium to convey the motions of gravitation as well as light; he comes in the next place to treat more particularly of body and motion, explaining what he understands by each of them, and then treating of motion, says that the two great laws of motion are light and gravity, and, having before treated of the former, he comes to explain the latter more particularly when, having shown that there is such a thing as gravity, with the limits and proportions of its power, and that it exerts it in all bodies, he comes at last to the principal part, the cause of gravity, and after the enumeration of its properties, gives his explication and hypothesis of the cause thereof. The author designed to have answered several objections against this his hypothesis, but having replied to one only, the discourse ends. To supply this defect, I have added some fragments which I found relating to the same subject, which the reader will find immediately annexed."

"All solid celestial bodies, then," says Hooke,[52] "have two properties; first a faculty of emitting or reflecting light; secondly an orbicular figure.... The second property of their orbicular or spherical form is an indication of another active principle which I conceive universal to all solid bodies in nature, and that is, of a gravitation or power of attracting similar solid bodies towards their centers. Which two principles I take to be the most considerable and the most active in nature and those from which the most considerable effects are produced; and when they are understood and explained as they ought, I

[52] *Ibid.*, p. 166.

question not but that they will afford us solutions and reasons for a thousand phenomena, the explication of which does now so much puzzle and perplex us."

From his observation he deduced,[53] among other things, that "the power of gravitation is extended into the ether, without the atmosphere of bodies, and consequently that the atmosphere or air is not the cause of gravitation, but rather the ether, in which the atmosphere or air is but a kind of dissolution, as salt or tinctures are dissolved in water or other liquors, and that from thence comes even the gravitation of the atmospheres to their incompassed bodies; which we observe by many other experiments made here upon the earth. For it is evident that bodies in a receiver, exhausted or emptied of the air by means of the exhausting engine, or any other ways, have not less of gravity towards the perpendicular or center of the earth than the bodies in the open and free air; nay they are found to be proportionably heavier, by how much a body of the air, equal to them in bulk, has been found to be lighter than them; which is an experiment that has often been tried."

To prove these deductions, Hooke demonstrated "four particulars"; first explaining what notions his expressions are meant to convey.[54]

"I conceive then the whole of realities that any ways affect our senses to be body and motion. By body I conceive nothing else but a reality that has extension every way, positive and immutable, not as to figure but as to quantity; and that the body, as body, is the same whatever figure it be of, as a quart of water is a quart of water, or a certain quantity of body, though contained in a globe, cylinder, cone, cube, quart pot, or any other figured containing vessel: and as body, it is indifferent to receive any figure whatever; nor has it more extension in one than in

[53] *Ibid.*, pp. 168-169.

[54] *Ibid.*, pp. 171-172.

the other vessel, nor can it have less; nor is it more essentially a body when solid, as ice, than when fluid; that is, the minims of it are equally disposed to motion or rest in position to each other; and therefore body, as body, may as well be, or be supposed to be indefinitely fluid as definitely solid; and consequently there is no necessity to suppose atoms, or any determinate part of body perfectly solid, or such whose parts are incapable of changing position one to another; since, as I conceive, the essence of a body is only determinate extension, or a power of being unalterably of such a quantity, and not a power of being and continuing of a determinate quantity and a determinate figure, which the anatomists suppose. These I conceive the two powers or principles of the world, to wit, body and motion; uniformity of motion making a solid and difformity of the motion of the parts making a fluid, as I shall prove more at large by and by.

"By motion I understand nothing but an alteration, or power of alteration of the minims of a whole in respect of one another, which power may be increased or diminished in any assignable quantity; but the natural balance of the universe is reciprocal to the bulk or extension, or to the quantity of the other power, body.

"These two I take to be two single powers, which cooperate in effecting the most of the sensible and insensible effects of the world."

And again:[55]

"As for matter, that I conceive in its essence to be immutable, and its essence being expatiation determinate, it cannot be altered in its quantity either by condensation or rarefaction; that is, there cannot be more or less of that power or reality, whatever it be, within the same expatiation or content; but every equal expatiation contains, is filled, or is an equal quantity of *materia*; and the

[55] *Ibid.*, pp. 172-173.

densest or heaviest, or most powerful body in the world contains no more *materia* than that which we conceive to be the rarest, thinnest, lightest, or least powerful body of all; as gold, for instance, and ether, or the substance that fills the cavity of an exhausted vessel, or the cavity of the glass of a barometer above the quicksilver. Nay, as I shall afterwards prove, this cavity is more full, or a more dense body of ether, in the common sense or acceptation of the word, than the gold is of gold, bulk for bulk; and that because the one, viz., the mass of ether, is all ether; but the mass of gold which we conceive is not all gold but there is an intermixture, and that vastly more than is commonly supposed, of ether with it; so that the vacuity, as it is commonly thought, or erroneously supposed, is a more dense body than the gold as gold. But if we consider the quantity of the whole content of the one with that of the other, within the same or equal quantity of expatiation, then are they both equally containing the *materia* or body.

"This possibly may at first hearing seem a little paradoxical, if not absurd; however I doubt not but that by the sequel of my discourse I shall be able to make it somewhat more plausible, if not positively and undeniably demonstrate it so to be.

"The second principle or power, which is motion, is of a quite differing nature, and may be rarified and condensed, diminished or increased, within the same quantity of body or matter, in any proportion assigned; that is, the same quantity of the first power, body or part of matter, may receive any assignable quantity of the second, that is, any assignable degree of motion; and being possessed of it, it may communicate or lose any assignable part of what it has, and still the body, as body, remain unaltered and the same; for as it may be moved with any motion, how swift soever it be supposed; so may it move with indefinitely slow motions, and that so far as that the next step one

would suppose it must lose all its motion, and remain in entire rest, and unalterable of position, as to the contiguous body."

With regard to the second of the "great laws of motion which constitute the form and order of the world"—gravity, the first being light, Hooke[56] says:

"By gravity then I understand such a power as causes bodies of a similar or homogeneous nature to be moved one towards the other till they are united; or such a power as always impels or drives, attracts or impresses motion into them, that tends that way, or makes them unite. The universality of this principle throughout the whole and everything therein I shall afterwards have more occasion to explain when I come to the effects of nature in the lesser bodies. At present I shall only proceed to show it in the greater bodies of the world."

"There have been," says Hooke,[57] "as many differing opinions concerning the limits of this power: some extending it too far, and others as extravagantly too little; some supposing that wheresoever in the universe a terrestrial body should be placed, there it would have a tendency towards the center of the world or earth; and therefore that in the creation all the terrestrial matter of the chaos met together and made up the body of the earth. Others, on the other hand, have been too penurious in limiting its power to some few miles; some to fifty miles, others to a boundary that a cannon well charged with powder would be able to shoot a bullet out of its reach. But though they are both enough mistaken, yet they agree in this, that this power of gravitation does act at some distance above the surface of the earth."

On the next page, Hooke[58] asserts:

[56] *Ibid.*, p. 176.
[57] *Ibid.*, p. 177.
[58] *Ibid.*, p. 178.

"I say, moreover, that this power is not only placed in the earth, but that there is the like power in every globular body in the universe, whether sun or fixed star, planet primary or secondary, and in the cometical body included, as I have supposed, within the nucleus of white cloud appearing in the head."

There are many other intelligent remarks on gravity and the explanation by its means of celestial motions. But here our object is to collect what details we can of the growth and the conception of mass and its connection with "the quantity of matter."

The bodies most receptive of gravity, according to Hooke,[59] "are such as have their particles of the greatest bulk and of the closest texture. This the whole series of grave bodies will sufficiently manifest; and I shall afterwards prove, when I come to show the texture of body, what it is that causes bodies to be grave or heavy and what makes them light, and that it is not the quantity of matter contained within the same space, but the modification of that matter, and the receptivity it hath of uniform power."

"I cannot find by any certain experiment," says Hooke,[60] "that grave bodies do sensibly decrease in gravity, though further removed from the surface of the earth; which was the intent to an experiment I formerly tried at the top of the steeple of St. Paul's and at Westminster Abbey, and may now again be repeated with much more conveniency and greater advantage at the column on Fishstreet Hill. For by counterpoising two weights in a curious pair of scales, first at the top of the steeple and then letting down one of the weights by a wire of two hundred and four feet in length, the counterpoise remaining at the top in the scale, the *aequipondium* remained: whereas if the gravity

[59] *Ibid.*, p. 182.

[60] *Ibid.*, pp. 182-183

of the body had increased by approximation to the earth, the weight let down to the bottom must have weighed the heavier. But though the difference were insensible in so small an height, yet I am apt to think some difference may be discovered in greater heights, and in some more curious ways than those I then used, even in that height; for I shall in my following discourses plainly show from the theory thereof that there is necessarily a difference and that the power of gravity does decrease at farther and farther distance from the center of the earth, and consequently that the line of a projected descending body is not truly parabolical, but elliptical though it should be made *in vacuo,* where the impediment of the medium could make very little or no alteration."

Then he deals[61] with his hypothesis as to the cause of gravity:

"Suppose then that there is in the ball of the earth such a motion, as I, for distinction's sake, will call a globular motion, whereby all the parts thereof have a vibration towards and fromwards the center, or of expansion and contraction; and that this vibrative motion is very short and very quick, as it is in all very hard and very compact bodies: that this vibrative motion communicates or produces a motion in a certain part of the ether which is interspersed between these solid vibrating parts: which communicated motion causes this interspersed fluid to vibrate every way *in orbem,* from and towards the center, in lines radiating from the same. By which radiating vibration of this exceeding fluid and yet exceeding dense matter, not only all the parts of the earth are carried or forced down towards the center; but the motion, being continued into the ether interspersed between the air and other kinds of fluid, causes those also to have a tendency towards the center; and much more any sensible body whatever that is

[61] *Ibid.,* pp. 184-185.

anywhere placed in the air or above it, though at a vast distance; which distance I shall afterwards determine and show with what proportioned power it acts upon bodies at all distances both without and within the earth: for this power propagated, as I shall then show, continually diminishes according as the orb of propagation continually increases, as we find the propagations of the media of light and sound also to do; as also the propagation of undulation upon the superficies of water. And from hence I conceive the power thereof to be always reciprocal to the area of superficies of the orb of propagation, that is duplicate of the distance; as will plainly follow and appear from the consideration of the nature thereof, and will hereafter be more plainly evinced by the effects it causes at such several distances.

"This propagated pulse I take to be the cause of the descent of bodies towards the earth. But it may perhaps seem a little strange how the propagation of a motion outward should be the cause of the motion of heavenly bodies downwards. To make this the more intelligible, I shall mention an observation very commonly known amongst tradesmen; and that is, the driving of a hammer or axe upon the helve, which to do the easiest way, they commonly strike the end of the helve, holding the helve in their hand and the axe or hammer at the lower end hanging downward, by which means they not only make the axe to go on upon the helve, but make it ascend, if they continue striking, even to their very hand. To apply which observation to my present theory, I say that the medium of propagation is the helve, and the axe or hammer is the grave body that descends; so that at every stroke that is given by the globe of the earth to the propagating medium, one degree of velocity of descent is given to the grave body which is as it were the axe. Now according to the velocity of this vibrative motion of the earth, so must the power it commu-

nicates be stronger or weaker. Suppose for instance, there should be a thousand of these pulses in a second of time, then must the grave body receive all those thousand impressions within the space of that second, and a thousand more the next, and another thousand the third second, so that in equal times it would receive equal degrees of acceleration. And if a second of time were again subdivided into a thousand moments of time, the body would receive one degree of acceleration in the first moment, one more in the second, a third in a third, and so onwards; so that the compounded acceleration would be as one in the first second, three the next second and five the next, and so onwards; according as it is observed in the motion of descending bodies.

"The medium that propagates this motion, I suppose to be one part of that which permeates most bodies, which we call by the general name of ether, and thence it proceeds that the motion is communicated to every part thereof: and so the momentum of every body becomes proportioned to its bulk or density of parts, difform to the fluid medium that communicates the pulse."

Then he[62] begins to discuss objections that might be urged against it, when the manuscript breaks off abruptly.

Among the loose papers of Hooke's which are printed after this is "An Account of Dr. Isaac Vossius's Hypothesis of Gravitation, with some animadversions thereupon."[63]

PHILIP E. B. JOURDAIN.

CAMBRIDGE, ENGLAND.

[62] *Ibid.*, p. 185.

[63] *Ibid.*, pp. 201-202.

THE NEW MECHANICS.[1]

IN this world, as you know, nothing is final, nothing immutable; the most powerful, the most stable empires are not eternal: this is a theme the preachers abundantly develop.

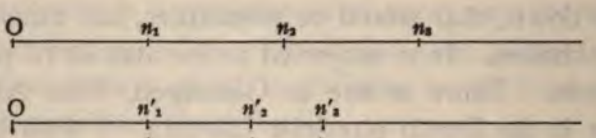
Scientific theories are like empires, they are not certain of the morrow. If any one of them seemed beyond the effects of time, it was certainly the Newtonian mechanics. It seemed undisputed, it was an imperishable monument; and behold in its turn, I shall not say the monument is thrown down, that would be premature, but anyhow it is greatly shaken. It is subjected to the attacks of powerful destroyers. There is one in Göttingen, Max Abraham, another is the Dutch physicist Lorentz. I wish to say a few words about the ruins of the ancient edifice and about the new structure by which it is sought to replace them.

First of all what is it that characterizes the old mechanics? It is this very simple fact: Consider a body at rest, impart to it an impulse, that is to say make a given force act upon it for a given time; the body moves, acquires a certain velocity; the body being impelled by this velocity, apply to it again the same force for the same time, the velocity will be doubled; if we still continue, the velocity will be tripled when we shall have given a third time the same impulse. So beginning again a sufficient number of times, the body will end by acquiring a very great velocity which can exceed all limit, an infinite velocity.

[1] Translated from the French by George Bruce Halsted.

In the new mechanics, on the contrary, we assume it to be impossible to communicate to a body starting from rest a velocity beyond that of light. What happens? Consider the same body at rest; give it a first impulse, the same as before, it will take the same velocity; repeat this impulse a second time, the velocity again augments, but it no longer will be doubled; a third impulse will produce an analogous effect, the velocity increases but less and less, the body opposing a resistance which becomes greater and greater. This resistance is inertia, it is what is commonly called mass; all this happens then in this new mechanics as if the mass was not constant, but increased with the velocity.

We can represent the phenomenon graphically: In the old mechanics the body after the first impulse takes a velocity represented by the sect On_1; after the second impulse On_1 increases by a sect n_1n_2 equal to it; at each new



impulse the velocity increases by the same quantity, the sect representing it increasing by a constant length. In the new mechanics, the velocity sect increases by sects $n'_1\,n'_2$, $n'_2\,n'_3$,.... which become smaller and smaller so that we cannot pass beyond a certain limit, the velocity of light.

How have we been led to such conclusions? Have we made direct experiments? The divergences only come out for bodies impelled by great velocities; only then do the indicated differences become perceptible. But what is a very great velocity? Is it that of an automobile making 100 kilometers an hour? We would go wild with excitement over such a speed in the street. But from our

point of view this velocity is still very small, a snail's pace. Astronomy does better. Mercury, the fastest of the heavenly bodies, also runs over about 100 kilometers, no longer per hour but per second. However, that still does not suffice; such velocities are too slight to reveal the differences we wish to observe. I do not mention our cannon balls; they are faster than automobiles, but much slower than Mercury.

You know that we have discovered an artillery whose projectiles are much swifter; I mean radium which sends out energy projectiles in every direction. The speed of this shooting is far greater, the initial velocity being about 100,000 kilometers a second, one-third the velocity of light. The caliber of the projectiles and their weight are, it is true much slighter and we cannot count on this artillery to increase the fighting power of our armies.

Can we experiment on these projectiles? Such experiments have been actually undertaken; under the influence of an electric field, of a magnetic field, a deviation occurs which enables us to take account of the inertia and to measure it. Thus we have ascertained that the mass depends upon the velocity and we enunciate this law: The inertia of a body increases with its velocity which remains less than that of light, 300,000 kilometers a second.

I pass now to the second principle, the principle of relativity. Suppose there is an observer moving to the right; everything is as if he were at rest, with the objects about him moving to the left. There is no way of knowing whether the objects really move, whether the observer is at rest or in motion. We teach in all courses on mechanics that the passenger on a boat thinks he sees the river bank moving, while he is gently borne along by the motion of the boat. Examined more closely, this simple idea acquires capital importance; there is no way of settling the question, no experiment can disprove the principle that there is no

absolute space, all displacements we can observe are relative displacements. I have often had occasion to express these considerations so familiar to philosophers. They have even given me a publicity I would gladly have avoided. All the reactionary French journals have made me prove that the sun turns around the earth. In the famous case between the Inquisition and Galileo, Galileo should be all wrong.

To return to the old mechanics. It admitted the principle of relativity; in place of being founded on experiments, its laws were deduced from this fundamental principle. These considerations sufficed for purely mechanical phenomena, but not for important parts of physics, for example optics. We considered the velocity of light as absolute with reference to the ether. This velocity could be measured. We had theoretically the means of comparing the displacement of a moving body to an absolute displacement, the means of deciding whether or not a body was in absolute motion.

Delicate experiments, apparatus exceedingly precise, which I shall not describe to you, enabled us to attempt the practical realization of such a comparison: the result was null. The principle of relativity admits of no restriction in the new mechanics; it has, if I may so speak, an absolute value.

To understand the rôle the principle of relativity plays in the new mechanics, we are led first to speak of apparent time, a very ingenious invention of the physicist Lorentz. We suppose two observers, the one A at Paris, the other B at Berlin. A and B have identical chronometers and wish to set them; but they are exceptionally scrupulous observers and require in their setting an extraordinary exactitude not only, for instance, to the second, but to the thousand-millionth of a second. How can they do it? From Paris to Berlin, A sends a telegraphic signal, by wireless,

if you will, to be wholly modern. B notes the moment of reception and this will be the starting time for both chronometers. But it takes a certain time for the signal to go from Paris to Berlin; it travels only with the speed of light. B's watch would therefore be slow. B is too intelligent not to take this into account, and he proceeds to remedy it. The thing seems very simple. They cross signals, A receiving and B sending; they take the mean of the corrections thus made and so have the exact time.

But is this certain? We are assuming that it takes the signal the same time to go from A to B as from B to A. Now A and B are carried along in the motion of the earth with reference to the ether, the vehicle of the electric waves. When A has sent his signal it flies on before him, B moving away in the same way, and the time employed will be longer than if the two observers were at rest. If, on the other hand, it is B who sends, and A who receives, the time is shorter because A goes to meet the signal. It is absolutely impossible for them to know whether or not their chronometers mark the same time. Whatever the method employed, the troubles remain the same. The observation of an astronomic phenomenon and all optical methods run against the same difficulties. B can never know more than an apparent difference of time, more than a species of local hour. The principle of relativity applies completely.

In the old mechanics, however, we prove with this principle all the fundamental laws. We might be tempted to take up the classic arguments and reason as follows. Suppose again two observers, A and B, to call them what we always call two observers in mathematics. Suppose them in motion, going away from each other. Neither can surpass the velocity of light; for example let B go at the rate of 200,000 kilometers toward the right; A of 200,000 kilometers toward the left. A may think himself at rest, and

the apparent velocity of B will for him be 400,000 kilometers. If A knows the new mechanics he will say: "B has a velocity he cannot attain, therefore I also am in motion." It seems he could decide about his absolute state. But he must be able to observe the motion of B himself. To make this observation A and B commence by setting their watches, then B sends telegrams to A to indicate to him his successive positions; putting them together A can reckon B's motion and trace the curve of this motion. Now the signals go with the speed of light. The watches which mark the apparent time vary at each instant and everything will happen as if B's watch went too fast. B will think himself going much less rapidly and the apparent velocity he will have relatively to A will not surpass the limit it should not attain. Nothing can reveal to A whether he is in motion or at absolute rest.

It is still necessary to make a third hypothesis, which is much more surprising, much more difficult to admit, and which greatly disturbs our present modes of thought. A body in motion of translation undergoes a deformation in the direction of its displacement: a sphere, for instance, becomes like a species of flattened ellipsoid with the short axis parallel to the translation. If we do not perceive such a transformation every day this is because it is so small as to render it almost imperceptible. The earth, borne along in its revolution through its orbit, is deformed about $\frac{1}{200\,000\,000}$. To observe such a phenomenon would require measuring instruments of extreme precision, but if their precision were infinite it would not avail, because they also are borne along in the motion and would undergo the same transformation. We should perceive nothing; the meter we could use would shorten like the length to be measured. We could not learn anything except by comparing the length of one of these bodies to the velocity of light.

These are delicate experiments, carried out by Michelson and I shall not expound their details; they have given results altogether remarkable. However strange it may seem to us, it is necessary to admit that the third hypothesis is perfectly verified.

Such are the bases of the new mechanics; with the help of these hypotheses we find that it is compatible with the principle of relativity.

But it is necessary to connect it then to a new conception of matter.

For the modern physicist, the atom is no longer the simple element; it has become a veritable universe in which thousands of planets gravitate around tiny suns. Suns and planets are here particles *electrified* either negatively or positively; the physicist calls them *electrons* and with them builds the world. Some represent the neutral atom as a positive central mass around which circulate a great number of negatively charged electrons, whose total electric mass equals in magnitude that of the central nucleus.

This conception of matter enables us easily to account for the augmentation of the mass of a body with its velocity, which we have made one of the characteristics of the new mechanics. Since a body is only an assemblage of electrons, it will suffice to show it to be true of them. To this end we note that an isolated electron moving through the ether engenders an electric current, that is to say an electromagnetic field. This field corresponds to a certain quantity of energy localized not in the electron but in the ether. A variation in magnitude or in direction of the electron's velocity modifies the field and expresses itself by a variation of the electromagnetic energy of the ether. While in the Newtonian mechanics the expenditure of energy is due only to the inertia of the moving body, here a part of this expenditure is due to what may be called the

inertia of the ether relatively to the electromagnetic forces. The inertia of the ether increases with the velocity and its limit becomes infinite when the velocity approaches the velocity of light. The apparent mass of the electron therefore increases with the velocity; Kaufmann's experiments show that the constant real mass of the electron is negligible in relation to the apparent mass and may be considered as null.

In the new conception, matter's constant mass has disappeared. Only the ether, and no longer matter, is inert. Only the ether opposes a resistance to motion, so that we might say that there is no matter, but only gaps in the ether. For stationary or quasi-stationary motions, the new mechanics does not differ—within the range of approximation of our measurements—from the Newtonian mechanics, with the sole difference that the mass is no longer independent either of the velocity or of the angle this velocity makes with the direction of the accelerative force. If, *per contra,* the velocity has a considerable acceleration, in the case, for instance, of very rapid oscillations, Hertzian waves are produced which represent a loss of energy of the electron involving the deadening of its motion. Thus in wireless telegraphy the waves emitted are due to the vibrations of the electrons in the oscillatory discharge.

Analogous vibrations take place in a flame and likewise also in an incandescent solid. Lorentz thinks that in an incandescent body a considerable number of electrons circulate which, not being able to get out of it, fly in every direction and are reflected on its surface. We may compare them to a swarm of gnats enclosed in a jar and striking with their wings against the walls of their prison. The higher the temperature, the more rapid becomes the motion of these electrons and the more numerous the mutual impacts and the reflections on the wall. At each im-

pact and at each reflection an electromagnetic wave is emitted and it is the perception of these waves which makes the body appear to us incandescent.

The motion of the electrons is almost tangible in a Crookes tube. There a veritable bombardment takes place of electrons issuing from the cathode. These cathode rays violently strike the anticathode and are there in part reflected, thus giving birth to an electromagnetic agitation which many physicists identify with the Röntgen rays.

In closing, it remains for us to examine the relations of the new mechanics to astronomy.

If the notion of constant mass of a body vanishes, what will become of Newton's law? It will hold good only for bodies at rest. Moreover it will be necessary to take into account the fact that attraction is not instantaneous. It may therefore well be asked whether the new mechanics will not result in complicating astronomy without obtaining an approximation superior to that given by the classic celestial mechanics. Lorentz has taken up the question. Starting from Newton's law, which he assumes to be true for two electrified bodies at rest, he calculates the electrodynamic action of the currents engendered by these bodies in motion. He thus obtains a new law of attraction containing the velocities of the two bodies as parameters.

Before examining how this law explains astronomic phenomena, we remark again that the acceleration of the heavenly bodies has as consequence an electromagnetic radiation, therefore a dissipation of energy making itself felt in return by a deadening of their velocity. Therefore, in the long run, the planets will end by falling into the sun. But this prospect can hardly frighten us, since the catastrophe can not happen for some millions of milliards of centuries.

Returning now to the law of attraction, we easily see

that the difference between the two mechanics will be the greater the greater the velocity of the planets.

If there is an appreciable difference, it will therefore be greatest for Mercury, which has the greatest velocity of all the planets. Now it happens precisely that Mercury presents an anomaly not yet explained. The motion of its perihelion is more rapid than the motion calculated by the classic theory. The acceleration is 38″ too great. Leverrier attributed this anomaly to a planet not yet discovered and an amateur astronomer thought he observed its passage across the sun. Since then no one else has seen it and it is unhappily certain that this planet perceived was only a bird.

Now the new mechanics explains perfectly the sense of the error with regard to Mercury, but it still leaves a margin of 32″ between it and observation. It therefore does not suffice for bringing concord into the explanation of the velocity of Mercury. If this result is hardly decisive in favor of the new mechanics, still less is it unfavorable to its acceptance since the sense in which it corrects the deviation from the classic theory is the right one. Our explanation of the velocity of the other planets is not sensibly modified in the new theory and the results coincide, to within the approximation of the measurements, with those of the classic theory.

In conclusion, it would be premature, I believe, in spite of the great value of the arguments and of the facts set up against it, to regard the classic mechanics as finally condemned. However it may be in other respects, it will remain the mechanics of very small velocities in relation to that of light, the mechanics therefore of our practical life and of our terrestrial technic. If however, in some years, its rival triumphs, I shall venture to point out a pedagogic danger that a number of teachers, in France at least, will not escape. These teachers will find nothing

more important, in teaching elementary mechanics to their scholars, than to inform them that this mechanics has had its day, that a new mechanics where the notions of mass and of time have a wholly different value replaces it; they will look down upon this lapsed mechanics that the programs force them to teach and will make their scholars feel the contempt they have for it. Yet I believe that this disdained classic mechanics will be as necessary as now and that whoever does not know it thoroughly cannot understand the new mechanics.

HENRI POINCARÉ.

HISTORY OF PLANT HYBRIDS.[1]

I. BEFORE 1761.

KNOWLEDGE of the existence of hybrids between various species of animals, especially between the horse and the ass, reaches back into the dim past. The conception of the possibility of hybridizing plants arose as soon as the sexuality of the higher plants became known. Toward the end of the seventeenth century it appears that simultaneously in several botanists the view took root that the stamens are the male organs of the flowering plants. In the year 1676 Grew brought before the Royal Society in London, in a paper which was published in 1682, Sir Thomas Millington's ideas concerning the sexual functions of anthers, which had not until then been made known.

The theory of the sexuality of the higher plants became more firmly grounded through Rudolf Jacob Cammerer (Camerarius) of Tübingen, who made his first experiments in 1691, and in 1694 published his *Epistola de Sexu Plantarum.* At that time he called attention to the possibility of the origin of plant hybrids, and later this question was often discussed by scientists but mainly only theoretically.

J. G. Gmelin saw several new larkspurs originate in his garden and decided upon their hybrid origin.

Linnaeus arrived at the opinion that the self-evident relationships of the species of plants could be explained

[1] Translated from the German by F. L. and E. H. Lewton.

by a common descent. He derived all the species which agreed in the construction of their flowers from the same mother stock, and all those plants resembling one another in form and shape of leaves from the same father stock. Following this same thought farther it appeared to him possible that the entire kingdom of plants was derived from a comparatively small number of originally created basic types. Holding this opinion, the study of newly-formed plant hybrids naturally had for him a special importance. One cannot state that he was especially fortunate in these investigations; upon superficial resemblance he declared as hybrids a number of plant forms which were of widely different parentage. Among those which were named spontaneous hybrids by him there are found only a few true hybrids. One of these is *Verbascum lychnitis* × *Thapsus*. But Linnaeus began to inaugurate experiments in artificial hybridization and with a little more patience would have arrived at important conclusions. He pollinated, for example, *Mirabilis longiflora* with pollen from *M. Jalapa*, an experiment which need only to have been reversed in order to have arrived at a remarkable hybrid. Linnaeus seems to have achieved good results in the crossing of *Tragopogon pratensis* and *T. porrifolius*. So far as I know no one has repeated the experiment, but the objections which have been brought forth by Koelreuter and others against the hybrid nature of the crosses described by Linnaeus can not be regarded as refutations because they refer to plants in the second generation. Linnaeus's *Tragopogon* is therefore, probably, the first plant hybrid originated for scientific purposes. It bloomed in 1759. Already much earlier, and even before 1719, an English gardener, Thomas Fairchild, had successfully crossed two pinks. The hybrid thus achieved, *Dianthus caryophyllus* × *D. barbatus*, was grown 100 years later in English gardens, and perhaps still is, as Fairchild's Sweet William.

This success in artificial fertilization was neither used for science nor does it seem to have given the gardeners an incentive to further investigations.

In spite of these isolated successful crosses the true history of plant hybridization does not begin before 1761; all that went before has more or less a traditional character, the few facts are buried beneath doctrinarian fantasies. As we have already said, Linnaeus made the attempt to gain firm ground in this realm, but it was Koelreuter who really founded the study of plant hybridization.

II. 1761—1799.

Joseph Gottlieb Koelreuter (born April 27, 1733, in Sulz on the Neckar; died at Karlsruhe, November 12, 1806) succeeded, after several unsuccessful attempts with other plants, in getting seed from a plant of *Nicotiana rustica* which he had fertilized with the pollen of *N. paniculata*. The hybrid plants derived from the above, bloomed in 1761. In this same year (1761) appeared the *Vorläufige Nachricht von einigen das Geschlecht der Pflanzen betreffenden Versuchen und Beobachtungen,* in which Koelreuter tells about his hybrid. In the same manuscript he told of a series of experiments whose full importance has only lately been recognized. He discovered the part played by insects in the fertilization of flowers; he determined the number of pollen grains which are needed for complete fertilization; and he gathered the nectar of flowers and showed that it was a solution of honey. In spite of the slight sympathy which he met with, Koelreuter continued his experiments and observations for several decades. All the essential characters of plant hybrids were correctly recognized by him. He fertilized, for example, a plant of *Nicotiana rustica* and its descendants regularly with pollen from *N. paniculata* through a period of generations (up to 20). In this way he transformed the first named species

into the second, and then with pollen of *N. rustica* brought it back again to the original mother form. He tried similar experiments with several species of *Dianthus*. He found out that the hybrid progeny of two species generally show an intermediate type and as a rule resemble each other exactly, it being immaterial which of the two types was used as the mother or father stock. The fertility of the crosses between several varieties of one species; the sterility or diminished fertility of hybrids between different species; the, as a rule, conspicuously greater growth of hybrids; and a mass of other remarkable facts were all carefully observed by Koelreuter. Although he knew of a number of cases of the spontaneous origin of garden hybrids, he never succeeded in finding natural plant hybrids. His successful crosses are principally between the species of the genera *Aquilegia, Matthiola, Dianthus, Melandryum, Linum, Malva, Lavatera, Lobelia, Nicotiana, Datura, Lycium, Verbascum, Digitalis,* and *Mirabilis.* But entirely apart from hybridization Koelreuter could through careful observation take glimpses into the household of Nature, the importance of which was not recognized till a hundred years later. Those important discoveries which were given in his first essay, have already been mentioned. Besides these he recognized the impossibility of the self-fertilization of many species of plants and the distribution by means of birds of plants bearing berries. He also made far-reaching investigations concerning the form of pollen grains.

Koelreuter's contemporaries gave his researches comparatively little attention, but science is indebted to the St. Petersburg Academy for the publication of his later works. With the exception of him and his brother Christoph Cunrad, hybrid plants seem only to have been raised by a few gardeners and flower lovers. For example *Papaver somniferum* × *P. orientale* in the Botanic Garden

at Edinburgh, also *Pelargoniums* by Wiegmann, Zeyher and others. It was not until 30 years later that Hedwig repeated the fundamental experiment of crossing *Nicotiana rustica* with *N. paniculata.*

Important observations concerning the morphology of the flower and provisions for fertilization in the Compositae were published by an Italian, Count Lavola, in the year 1764 in his *Discorso della irritabilita d'alcuni fiori nuovamente scoperta,* etc. Much later, in 1793, Conrad Sprengel's celebrated work appeared: *Das endekte Geheimness der Nature im Bau und in der Befruchtung der Blumen* ("The discovered secret of Nature in the construction and fertilization of flowers"). It is rich in interesting and exact observations concerning the relation between the form of the flower and insect visitors. These experiments appeared as a continuation and further development of Koelreuter's investigations which he had made public more than thirty years before. At that time they were given but little attention by scientists.

Toward the end of the eighteenth century another man appeared whose works concerning fertilization and hybridization have become of special importance, namely, Thomas Andrew Knight, the celebrated fruit and vegetable grower. Through the successful endeavors of the animal breeders, who tried to improve the domestic animals by crossing the different races, he came to asl the question if it were not possible by crossing races to obtain improved kinds of useful plants. Without knowing anything of Koelreuter he began his experiments with fruit trees and in 1787 with peas, by means of which he could get definite results much sooner. The progeny of his crosses between the races of peas made extraordinary gains in vigor and fertility. As early as 1799 Knight states "that nature intended that sexual intercourse should take place between neighboring plants of the species" (*Philos. Transactions,*

1799, Part II, page 202). He based this sentence upon his experiments with individual and race crosses, especially in the genus *Pisum*.

The important facts of fertilization had therefore been correctly recognized and made public at the end of the eighteenth century by several investigators. Koelreuter had discovered the importance of insects in the fertilization of plants; Conrad Sprengel had followed out in all their details the relationships between flowers and insects; Thomas A. Knight had demonstrated the advantages of crossing races. Although a few recognized the value of these facts this knowledge was not generally accepted and made a part of science. The real scientists followed the way opened to them by Linnaeus; they considered of most importance the recognition of species and their correct placing in genera and the higher systematic orders. But it is judging the spirit and endeavors of the time too superficially and too one-sidedly to believe that the species dogma crippled the free movement of thought.

The belief of the constancy of species was at that time not especially firmly grounded. Linnaeus himself, as we have before mentioned, was guilty of grave heresies against the doctrine of absolute and constant species. Medikus, the friend of Koelreuter, regarded as of no importance the question whether a genus comprised three different species or one species with three varieties. Duchesne, who introduced the conception of races into botany, was certainly far from believing in the constancy of species. Only the lack of a better understanding of known phenomena and facts prevented these and certainly many other men from taking a firm stand against the doctrine of the constancy of species. One would therefore be wrong in charging to doctrinal bigotry the fact that the discoveries of Koelreuter, Sprengel and Knight were so little regarded and understood. The truth is that these discoveries did not fit into

the idea of nature then current, for they could not be reconciled with then known facts and therefore were disregarded.

III. 1800—1825.

In 1800 there appeared J. E. Smith's *Flora Britannica*, a work in which for the first time two spontaneous hybrids between native species were introduced as parts of a European flora and expressed as *"β var. hybrida."*

To be sure, the hybrid *Verbascum thapsus* × *nigrum* was observed only in gardens and could therefore be classed with similar hybrids recorded by Linnaeus and Koelreuter. *Verbascum pulverulentum* × *nigrum* was, on the other hand, a true, spontaneous hybrid, originating in the wilds.

In 1809 there followed communications by Villars, concerning spontaneous hybrid *Gentians* (*Roem. Coll. Bot.*, p. 186), and in the following year a paper by J. D. Hoppe concerning a hybrid *Aconitum* (*Neues bot. Taschenbuch*, 1810, p. 217). The first clear and detailed description of the circumstances under which a wild-growing hybrid was observed, was given in 1823 by Guillemin and Dumas in their "Observations sur l'hybridité des plantes" (*Mém. Paris Soc, hist. nat.*, I, 79-92). As regards French achievements at this time in the realm of hybrids there may be mentioned the experiments of Sageret which were begun before 1820. From Bellardi there appeared in 1809 an article (*Saggio Botanico-Georgico*) in which were described several experiments on hybridization with cereals.

The disputes of the German scientists over the sexuality of plants and hybridization are noteworthy for their extraordinary fruitlessness. Schelver critically reviewed the theory of the sexuality of plants but did not find it sufficiently well grounded; which decision, however, was only possible because he cast aside Koelreuter's investigations and de-

ductions as unworthy of belief. Henschel further strengthened the belief in the non-sexuality of plants in that he tried to replace a total lack of uprightness and sense of truth by a skilful sophistry and by the overwhelming shamelessness of his assertions. The defense of the sexual theory was taken up mainly by L. Chr. Treviranus, who demonstrated in a strictly scientific way the facts in the case. But his laborious manner of writing could not compare with the unscrupulous arguments of Henschel, so that the latter, who was favored by those in power, seemed for a time to be the conqueror in this war of opinions. The quarrel partly turned on the truthfulness and trustworthiness of Koelreuter's assertions. Nothing would have been easier than that Treviranus, who believed in Koelreuter, should have repeated several of his experiments, which, after the way had once been shown, would certainly not have been too difficult for the superintendent of a botanical garden. Instead of that he allowed Henschel, who really made some experiments in hybridization, to surpass him even in this field. Henschel used these experiments for swindling instead of for earnest investigations. It would be an insult to the dignity of science to waste even a word over the assertions of Henschel. It is sufficient, as Godron has done, to mention Henschel's pretended hybrid between *Spinacia oleracea* and *Pinus strobus* to show the justness of this contempt. Finally, about the year 1819, the desire for reliable experiments in hybridization became more general.

While German science during the first quarter of the nineteenth century could show only unimportant or ignominious performances in the field of hybridization, English gardeners and flower-lovers, at the same time, made a great number of enlightening experiments. To be sure these were mainly in gardening but were also of scientific interest. Knight continued his crosses between different races or nearly related kinds of fruits and vegetables.

About 1808 R. J. Gowen, gardener of Lord Carnarvon of Highclare, and the English priest W. Herbert, began their long series of successful experiments in crossing plants, principally between species of *Erica, Rhododendron, Gladiolus* and *Hippeastrum.* A gardener, Thomas Milne, obtained the first hybrid in *Passiflora.* Robert Sweet busied himself with crossing species of *Pelargonium* and took great pains to establish the many varieties of *Pelargonium* raised by other plant-lovers and gardeners. Sweet's work, *Geraniaceae,* is perhaps the most comprehensive writing on hybridization which appeared during the first quarter of the nineteenth century. However, until now, not a single investigator in this field has paid any attention to it.

On the other hand, a sensation was aroused by the lively exchange of ideas between Knight and Herbert in the meetings and publications of the London Horticultural Society. Knight maintained that the hybrids between specifically distinct types were always sterile; fertile hybrids were always the result of crossing varieties. He said the fertility of a hybrid between two types, heretofore held to be different species, would, in spite of their dissimilarity, show that these were only varieties of a single species. (*Transactions Hort. Soc.,* London, IV, 367-373.) Herbert, on the other hand, had found that hybrids between manifestly different species are often fruitful; but he agreed with Knight in acknowledging that the possibility of producing a fertile hybrid or even a fertile cross between two plants, showed their original genetic relationship. He held that at one time there were only generic and family types which probably may not have exactly agreed with the present divisions of the botanical system. From these original types he derived the modern species not like Linnaeus, through hybridization, but like Lamarck and G. R. Treviranus, through "differentiation."[2]

[2] "I suspect that in the early periods of the world, there existed only the

The kernel of the whole dispute was the question of whether there existed a sharp and immovable boundary between fertility and infertility of the hybrids; but behind this question there was really a second, namely, whether there existed a sharp boundary between species and varieties. Species-hybrids should be sterile, variety-crosses fruitful. The Knight-Herbert discussion was a prologue to the later Cuvier-Geoffroy quarrel, which was played upon a much larger stage and with more comprehensive knowledge on the part of the actors.

IV. 1826—1850.

In England, the year 1825 continued to make additions to the history of hybrids. The gardeners continued to produce numerous hybrids and through Sweet, G. Don, Paxton, Lindley, Herbert and others, much has become known concerning the results of these crossings. The communications of Herbert, in an appendix to his work on the *Amaryllidaceae* and in a special essay in Vol. II of the *Journal of the Horticultural Society,* are most comprehensive. These papers were founded upon his own experience and that of others. His views are in general clear and reliable, even though not always complete enough for the strictly scientific investigator. At any rate, he has done more for the furtherance of our knowledge of hybrids than any other writer during the last half of the nineteenth century. In contrast to Koelreuter, Gaertner, and many later writers, he made his experiments almost entirely upon long-lived perennial plants.

During the period between 1825 and 1850 France can show especial achievements in hybridization. Several noteworthy papers we owe to Sageret and Lecoq, and several

distinct genera of plants, or heads of families, not however, exactly according to the present divisions of botanists." (*Trans. Hort. Soc.,* London, IV, 16.) Later, Herbert compared the origin of species from a common parent form with the development of the languages from a few original languages. (*Amaryllidaceæ,* p. 339.)

gardeners made observations upon accidental or intentionally made hybrids. In 1844 there appeared Godron's first work upon hybridity in the plant kingdom, with descriptions of some hybrids found growing wild.

More noteworthy are the German works during this period, although in reality they only sufficed to expose Henschel's deceptions and to substantiate to the highest extent Koelreuter's observations. By the agitation of Link, the Berlin Academy of Sciences in 1819 and again in 1822 offered a prize for an answer to the question: "Can hybrids be formed in the plant kingdom?" Finally there was sent in a paper by A. F. Wiegmann, to whom in 1826 half the prize was given. This work was published in 1828 under the title: *Ueber Bastarderzeugung im Pflanzenreiche.* The author agreed entirely with the views of Koelreuter and Conrad Sprengel. He made a number of unquestionable hybrids, besides some variations which he considered hybrids, the cause of whose origin has not even to-day been determined. In the years following there were published several papers concerning successful crossing; for example, those of Christian Lehmann.

Of greater importance are the investigations of Carl Friedrich Gaertner (May 1, 1772 to Sept. 1, 1850). The first published work of this hybridizer was, to be sure, very presumptious. He had carefully studied the writings of Koelreuter and in the year 1825 made a great number of experiments in pollenization. He now wrote an essay on hybrid fertilization (*Naturw. Abh.,* Tübingen, I, 1), in which he pretended to be an experienced hybridizer and gave the results of his pollinations, most of which, as was later discovered, were only apparently successful. This essay was translated into French, and was undeservedly published in *Ann. sc. natur.,* X, 113-148 (1827). The tone of ripened experience which Gaertner adopted misled many to believe in his supposed results and in addition the sup-

posedly successful fertilizations were confused with the successful ones. This paper therefore became the source of great mistakes, though not entirely through the fault of the author. Later Gaertner was able to report an increasing number of actually obtained hybrids (published in *Flora*), and he continued his crossings through several decades. In number of experiments he has probably not been surpassed by any other hybridizer. His book: *Versuche und Beobachtungen über die Bastarderzeugung im Pflanzenreiche*, comprises the essential features of two of the author's papers which were submitted in competition for the prizes offered by the Kgl. Niederl. Akademie der Wissenschaften in 1830 and 1836,[3] together with communications offered in his scattered essays. It might be regarded as a working over of all the results obtained by his various experiments. Unfortunately, this very comprehensive work is extraordinarily dull; it is therefore on the one hand not well enough known and on the other its value is frequently overestimated. It is difficult to obtain a decided opinion upon the trustworthiness of the views expressed because the book contains numberless inaccuracies and contradictions. A careful, special study has convinced me that the mistakes in Gaertner's work were caused by an extraordinary lack of ability as a writer and his incapability to arrange in order his observations and facts. According to all appearances the author used his scattered notes concerning his observations about hybrids without ever reporting the deficiencies and incompleteness of the first investigations, even though later experiments showed entirely different results. Only thus can it be explained that the statements so often contradict each other. Among others, the remarks concerning the *Passiflora* hybrids on pages 241, 242, 288, 332 and 337 are characteristic. These

[3] The paper published in the Dutch language is little known and I have not yet seen it.

show how little Gaertner was able clearly to set forth a simple fact. Such sentences, in which the cause of the contradicting assertions can be seen, give the key to the understanding of the means of origin of many other wrong statements. The material which Gaertner worked over is confined almost exclusively within the lines laid down by Koelreuter.

Even though Gaertner's work is a well-filled revision of hybridization studies, one must never forget that it should be used with great caution and critical circumspection. More important and of greater service are Gaertner's investigations concerning the normal processes of fertilization.

Another branch of hybrid investigation reached conspicuous importance in Germany during the second quarter of the nineteenth century. Several able botanists had directed their attention about 1825 toward the hybrids found in a wild state. A. Braun, Wallroth, Zuccarini, G. W. F. Meyer, Ziz, W. D. J. Koch, and others, had recognized a number of spontaneous hybrids. Schiede, who had himself actively taken part in these investigations, collected all hitherto known facts on this subject. His little paper: *"De plantis hybridis sponte natis,"* appeared in 1825 and should be regarded as a forerunner in the study of hybrids in nature. Lasch and L. Reichenbach soon added new examples to the known cases of spontaneous hybrids, so that by 1832 A. P. de Candolle was able, in his *Physiol. végét.*, to complete Schiede's list. Especially valuable were later the careful investigations of C. Nägeli concerning hybrid *Cirsiums.* Fr. Wimmer, in connection with several friends (Krause, Wichura and Siegert), investigated with great success the hybrids in the Silesian flora. In spite of many mistakes in details correct knowledge concerning spontaneous hybrids made rapid progress. The conservative florists, to be sure, wished to know nothing of the many

hybrids, also many others, zealous for the doctrine of the constancy of species (for example Hornschuch), were against accepting so many because they were more inclined to believe in variations and intermediate forms.

V. 1851—1880.

The year 1850 marks a natural division in the history of hybrids. The death of the two most prominent hybridists in the first half of the century (Herbert in 1847 and Gaertner in 1850) on the one hand, the appearance of new investigators on the other, would have been sufficient to show a dividing line, even if there had not at the same time been developed a new tendency in the aims and endeavors of the investigators of hybrids. The first incentive to a lively discussion of the hybrid question came from J. F. Klotzsch. In a paper (*Verh. Kgl. Preuss. Akad.*, Berlin, 1854, pp. 535-562) he stated, among other assertions, that hybrid pollen is always sterile, that hybrids can never be fertilized with their own pollen, or with that of a third species, but only with the pollen of the parent form. In opposition to the experiences of Koelreuter, Gaertner, Herbert and numerous gardeners, this assertion was, in truth, more than bold. The first person who positively opposed this statement was E. Regel, who at that time had already had an extensive experience in the growing of hybrid *Gesneraceae*. Even though his crosses were made for gardening purposes, he did not lose sight of the scientific side of the question. Some of his most convincing proofs were taken from the genus *Begonia*, which Klotzsch had chosen for his especial study.

The usefulness of the discussion consisted principally in bringing to light a number of facts which otherwise would have remained entirely unknown. Moreover, for any unprejudiced person there could be no doubt in this case that Regel was entirely right.

Almost at the same time there developed in France another quarrel; namely, that concerning the *Aegilops* question. It was A. Godron who first destroyed the fanciful notions concerning the transformation of *Aegilops* into *Triticum,* through the origin of the artificial hybrid *Aegilops triticoides,* and who also proved by experiment that *Aegilops speltaeformis* came true to seed. A. Jordan's criticism of Godron's experiments, which is of value even at the present time, resulted in Godron and others (Grönland and Regel) endeavoring to establish the facts through repeated experiments in all directions.

The Klotzsch-Regel and Jordan-Godron discussions gave the incentive to further important investigations. On Jan. 30, 1860, the Paris Academy of Sciences decided to make use of a prize, which had been placed at its disposal, and to award it in the year 1862 for the best paper on "Hybridization in the Plant Kingdom." The Academy especially hoped to draw attention to three points, namely: the fertility or unfertility of hybrids; the cause of sterility, whether due to the pollen or the female organs; and finally the constancy of fertile hybrids through reproduction by seeds. Apparently the period of three summers which lay between the offering and the awarding of the prize, was much too short to begin and finish important new investigations. The Academy could only hope that the prize would be an incentive to a zealous continuation on the part of such men as had already busied themselves for some time with hybridization experiments, and to the publishing of the results of their endeavors. Two papers were handed in which were founded upon numerous experiments, the authors being Chas. Naudin and D. A. Godron. For sufficient reasons the Academy declared the work of Naudin to be the better and awarded him the prize, giving the work of Godron only honorable mention. The criticism of Duchartre on the decision of the Academy concerning God-

ron's work was not entirely without foundation. There is no doubt that in many respects Godron worked more carefully and thoroughly than his opponent. If one gives this scientific achievement a careful scrutiny it will be found surprising in one respect. In this prize paper Godron did not include all his former experiments, but considering everything the two experimenters described about thirty long series of experiments and noteworthy single experiments, to which must be added several incomplete observations and communications on facts long known. If one contrasts therewith the great mass of material which the investigations of Koelreuter, Herbert and Gaertner, not to speak of others, have furnished; then the material used by the two French investigators, though very useful, was apparently insufficient for a comprehensive and in some measure finished opinion on the subject.

Godron, as well as Naudin, founded his views concerning hybridization almost entirely upon his own investigations; the incomparably larger amount of his own and foreign experiences which Gaertner used in writing his work, was given practically no consideration. Moreover the two contestants had formed different ideas concerning the purpose of the prize. Naudin declared, clearly and decidedly, that in the meaning of Cuvier's theory there were no sharply defined species. "There is no qualitative difference between species, races and varieties; in searching for it one is pursuing a chimera. The three things are one, and the words by which one pretends to distinguish them, indicate only the degree of contrast between the comparative forms." (Cuvier, in *Ann. Sc. Nat. Bot.*, 4 ser., XIX, 201.) Naudin therefore saw no ground for considering nearly related but well characterized forms as anything else than distinct species. He found that there existed fertile and unfertile hybrids, but that the descendants of the fertile

hybrids more or less rapidly reverted to the parent type. Upon this last point Naudin placed the greatest weight.

Godron held fast to Cuvier's idea of species and was then still of the opinion that all hybrids between true species were entirely sterile[4] but were capable of being fertilized by the pollen of the parent forms or by that of another species. He held that through such recrossing there originated the richness of forms in the progeny of hybrids; that in general, the new forms would, in case they were protected from further crossing, be fixed and come true to seed. Fertile hybrids, in the first generation, isolated from their parent and related species, were not considered by Godron to be true hybrids between species, but were "blendings" whose parent forms were only races of one and the same species. Godron's entire view-point was governed by his experiments with the hybrids between *Aegilops* and *Triticum,* while Naudin was guided preferably by his observations on the *Solanaceae* and *Cucurbitaceae.* These two works are the sources from which numerous later botanical writers drew their views concerning plant hybrids; but no unprejudiced person will deny that in true worth they are conspicuously behind the works of Gaertner. The discouraging dullness and terrible confusion of the German investigator's presentation makes a study of this work, which is so rich in facts, very disagreeable; while the two Frenchmen developed their views in short, clear essays written in a fascinating manner. Their works, especially Naudin's, won in importance because the award by the French Academy stamped them as classics. The circumstance that the two authors contradicted each other in essential points should be regarded as fortunate for science, for otherwise their assertions would for a long time have been regarded as unassailable. Moreover, both Naudin and Godron continued their experiments so that their

[4] In his later articles Godron did not adhere to this mistaken opinion.

services to the science of hybridization are by no means to be found only in their competitive essays.

The next most important work concerning hybrid plants appeared in 1865. It was Max Wichura's *Die Bastardbefruchtung im Pflanzenreich, erläutert an den Bastarden der Weiden.* The numerous and painstaking experiments made by the author himself, are restricted to the genus *Salix,* in which he combined as many as six species into a single compound hybrid. In contrast to Godron, he confirmed the views of Koelreuter, Herbert, Gaertner, Naudin and others, that hybrids are frequently fertile to their own pollen, and also found, in contrast to Naudin, the progeny of hybrid willows to be constant. He thereby refuted the mistakes of his two nearest predecessors, whose works, moreover, he seems not to have known at all.

During the years 1865 and 1866 there appeared several noteworthy essays by C. Nägeli concerning the formation of hybrids in the plant kingdom. (*Sitzungsber. Akad. München, Math.-phys. Cl.*, 1865, II, 395; 1866, I, 71 ff., 190 ff.). Nägeli did not himself make any experiments in hybridization but he carefully observed numerous wild-growing hybrids. He was much more familiar with the literature of the subject than was Naudin, Godron or Wichura. For example, he deducted from the given facts in Gaertner's works the consequent conclusions. It was first through Nägeli that science was able to make use of the fruits won by Gaertner's experiments. To be sure Nägeli acquired some of Gaertner's tendency to doctrinarian views and the presentation of general theoretical dogma. Especially is this true in regard to Nägeli's theory of *Bastardirungsäquivalent,* in which he seeks to express numerically the degree of the resemblance of the hybrid descendants with the parent forms. He takes into consideration first, the part which each parent form takes in the production; second, the typical strength of these parent

forms, counting the number of generations needed to bring about the transformation. The fluctuation of characters, which is so common among the progeny of hybrids, as well as the tendency of reversion to the parent form, is sufficient to overthrow any such hypotheses and calculations. There is just as little support for the theory for the different influences of the male and female elements upon the characters of hybrids. Nägeli especially emphasizes the fact that it is immaterial for the systematic characters of the hybrids which of the parent species was the male or the female progenitor. The confidence which he put in Gaertner's statements would, by means of a sufficient number of his own experiments, have put him upon the right track. It is without doubt through Nägeli, that the theory of hybrids in the plant kingdom was for the first time completely demonstrated in an unprejudiced and connected manner. The scientific service of these works must be credited with great importance; they have been the source from which the text-books (like that of Sachs) and most of the later theoretical views concerning hybrid plants have been derived.

It is only necessary here to call briefly to mind the importance of Darwin's work on the doctrine of hybridization. To be sure Darwin's own experiments extended only in a few cases to crosses between species, but with great success he connected his investigations with Knight's experiences in the behavior of crosses between individuals and races. Moreover his experiments in the artificial fertilization of heterostyle species are extraordinarily useful.

Of recent scientific experiments in crossing Robert Caspary's hybridizations in the *Nymphaceae*, G. Mendel's with *Phaseolus* and *Hieracium*, D. A. Godron's with *Datura*, *Aegilops*, *Triticum* and *Papaver*, have to be regarded as especially instructive. Godron's series of experiments with *Datura* hybrids may be considered as the most prominent.

Through these experiments the fact was established, that from fertile hybrids having highly variable progeny, there can be produced, in the course of a few generations, races having mixed characters and coming true to seed. For new actual experiments with the characters of hybrids we have to thank Godron more than any other investigator of the nineteenth century.

The numerous crosses which were carried out by Gaertner during the last ten years have advanced the scientific knowledge of hybrids comparatively little. But of great interest are the hybrids of *Sarracenia, Nepenthes,* and numerous orchids produced by the English breeders, Seden, Dominy and others. Kellermann has communicated good observations concerning the hybrid *Araceae* raised by him.

Since 1830 the study of wild-growing hybrids has made important progress. To be sure the unprofessional have worked in the field as zealously as the professional; a careful examination of their views is therefore urgently requested; also because most of the florists have known little more to tell than the recognizable characters of the hybrids observed by them. The most numerous and important communications concerning wild-growing hybrids have been offered by Fr. Schultz, Timbal-Lagrave, Grenier, A. Kerner, Wirtgen, Michalet, Ritschl, Beckhaus, P. Ascherson, R. von Uechtritz, J. Schmalhausen, C. Haussknecht and V. von Borbás, not to mention numerous local florists.[5]

Through Fr. Schultz the investigations were often led into false paths, in that this erudite botanist held, with a certain fanaticism, the view that each hybrid combination appeared in two forms, according to which one of the parent species had yielded the pollen. He regarded it to be his duty, when finding a hybrid, to recognize from its characters which of the parent species had been the seed parent and which had yielded the pollen. His example

[5] Nägeli, Godron, Wimmer and others have already been named.

misled others to similar mistakes. Only gradually has this trifling been given up. On the other hand there has recently come to the front a tendency to use hybrids as material for the manufacture of new names. Nevertheless our knowledge of spontaneous hybrids has been considerably widened through the observations of the florists. One of the newest pertinent treatises; namely, that of J. Schmalhausen (*Bot. Zeit.*, 1875, pp. 520, 534), indicates how in the future the study of spontaneous hybrids may be of real use to science.

There was published by K. A. Kenniger in 1879 in the 62d volume of *Flora,* a compilation of the spontaneous hybrids found up to that time in Germany and Austria; remarks upon these by Otto Kuntze are to be found in Vol. LXIII, No. 19.

If one bears in mind the knowledge concerning hybrids in its principle features, he can take from it a decided lesson: *No greater mistake can be made than to try to generalize from a few single experiments.* Without doubt one can lay down well founded rules concerning the general behavior of hybrids, but one must not forget that for each of these rules more or less numerous exceptions will be found. In contrast to the unbending laws which rule inanimate nature, organisms show a certain freedom in their life phenomena, an unrestrained flexibility. Physiology must keep this fact in mind if it wishes to know and investigate with an unclouded view the transformations of which the plant form is capable under the influence of inner and outer forces.

WILHELM OBERS FOCKE.

BREMEN, GERMANY.

THE PRINCIPLE OF RELATIVITY AS A PHASE IN THE DEVELOPMENT OF SCIENCE.

THE principle of relativity made its appearance with great pretensions, and upset not a little the scientific world by its claim to antiquate the traditionally classical basis of physics, of astronomy, of mathematics, and of the other natural sciences. It affects especially the commonly accepted theory of the ether, and even the current views of space and time, which have hitherto proved serviceable. The entire realm of science was almost panic stricken for scientists seemed to have lost the *terra firma* under their feet; they felt as if they were sinking into a bottomless abyss and were left without a standing place in the whirl of a universal flux. Physicists of former date might take the movement for a joke, and many conservative thinkers find a good deal of humor in it, but the relativists are quite serious and are aware of the gravity of the consequences of their subversive work.

However, the new conception sailing under the flag of the principle of relativity which has been so noisily advanced to replace the old notions, does not prove quite satisfactory and presents too many difficulties to be acceptable to the average mind. It consists mainly of contradictory and mystifying statements commonly called "the paradoxes of relativity," and these statements have been praised or ridiculed, accepted or rejected, by enthusiastic adherents or obdurate adversaries, so that we have a state of things not unlike the rise of a new religious creed as it sets out to conquer the world. The names of Einstein, Lorentz, Minkowski, are the stars of first magnitude among the founders of the new world-conception. Their arguments, mathe-

matically well excogitated and worked out with subtile exactness, seem to carry everything before them, and we are not prepared to say that their contentions are wrong. Their propositions decidedly contain truths of great importance, referring mainly to calculations of minute precision in complicated phenomena. Yet common sense rebels against them and would not be convinced. *Prima facie* the new doctrine seems *ingeniosius quam verius*; it is ingeniously contrived but there is a hitch in it.

In former articles[1] we have shown that the paradoxes have merely an appearance of contradictoriness; they can be explained as slightly misstated conclusions and so the relativists could have avoided mystification. If physicists had borne in mind that as a matter of course all determinations and calculations of measurement require a reference point which remains unaltered in its relations to other points within the field of observation and is assumed to be stable, the problem would never have arisen. The new cases of unstable reference points which make their first appearance in 1727 with Bradley's investigations would simply have demanded a corrective without in the least upsetting the traditional view, and this will after all be the outcome of the new movement. It is to be anticipated that in the long run the paradoxical features of relativism will disappear, and when the results of the new propositions will be formulated without ado in sober consistency, it will be found that they only modify the old traditional physics and astronomy under certain specially complicated circumstances, particularly when the place of an observer while making his observations possesses a motion of its own affecting the motions under observation.

It almost seems as if the entire proposition of the principle of relativity might as well have been abandoned be-

[1] "The Principle of Relativity," *Monist*, XXII, 188, and "The Philosophy of Relativity," *Monist*, XXII, 540.

cause the relativity of motion as well as of space, the field of motion, was not unknown to earlier physicists. Is not relativity the nature of space? Denunciations to the effect that earlier physicists and astronomers had believed in an absolute space are really a misconstruction of their views, for what Newton called absolute space did not involve a denial of the conditions about which the relativists have troubled their minds.

As a symptom of sobering down, we mention an article of Edward V. Huntington which appeared in the *Philosophical Magazine* for April, 1912, under the title "A New Approach to the Theory of Relativity," pages 494 to 513. After explaining experiments with synchronized clocks, Professor Huntington says on page 507 as follows:

"These are the famous paradoxes of the theory of relativity which are often cited as proof of the assertion that the theory of relativity is incompatible with our ordinary ideas of time and space, but which here appear as necessary consequences of perfectly natural and reasonable conventions for setting clocks and laying out coordinates."

Further Professor Huntington takes away the mystery from some other propositions of the relativity principle. He concludes that "thus all the transformation equations used in theorem 1, are obtained by an entirely natural and elementary method."

The question then arises, Has the appearance of the principle of relativity done nothing to promote science, or has it even been a mistake? And we say in answer that the principle of relativity might have approached its problem in a more conservative way simply by bearing in mind that former physicists were perfectly aware of the fact that whenever they made measurements they laid down a point of reference for their calculations. This reference point must share the motion of the phenomena observed, or at least the difference must (for the purpose in view)

be a negligible factor. We know very well, and all scientists of former generations also knew, that the stability of our reference point is a fiction, but without making this fiction our calculations would sink into the bottomless.

While the geometer calculates distances on earth, he knows very well that the reference point from which he starts is not absolutely stable but moves around the sun with the entire earth, including the objects and the distances to be measured. When astronomers took measurements of the stars they knew very well that their own telescopes were moving along through space with the velocity of the earth under their feet, but for the purpose in view this movement was a negligible factor. Both physicists and astronomers of former times took it as a matter of course that we know of no point of absolute rest, that everything is relative, and that thus there is no absolute space in which their systems of measurement held a definite and invariable position. In this sense the principle of relativity is not quite so new as its enthusiastic adherents frequently claim. The contradictions and paradoxes are merely on the surface, and there is little hope of replacing the old orthodox mechanics which will even in the times to come hold good for all the usual commonplace fields of observation.

For all that, we do not mean to belittle the principle of relativity; the new method has its advantages, and in certain spheres it will find its application. What the relativists have accomplished may be comparable to the invention of a micrometer which proves very useful in making minute measurements hopelessly out of reach of the coarser instruments used in daily practical life. But as the micrometer will not abolish the usefulness of the yardstick, so relativist considerations will not upset the commonplace view of traditional mechanics. There is no contradiction between the two, if only we rightly understand the philo-

sophical basis of the ordinary methods of measurement with their indispensable fiction of laying down a reference point and ignoring the negligible factors of changes that take place while observations are being made, changes that may affect size, time and distance. The need of an indispensable reference point, the assumption of which is always a fiction made for the purpose in view, will be felt no less in the more complicated considerations which have prompted the rise of the new mechanics of the relativists.

In order to satisfy the demand of the conditions to which relativists have devoted their special attention, we have simply to bear in mind that the assumption of reference points is absolutely indispensable for any kind of measurement.

We may therefore say that the relativists have proposed their new theory as new in neglect of comprehending the philosophical basis of the science of measurements. We may grant that in the traditional treatment of kindred problems it was perhaps ignored, yet we trust that it was tacitly assumed.

The principle of relativity is therefore not useless, for it is serviceable in a field where more complicated interrelations have to be observed; but if the relativists dig deeper they will find common ground with their predecessors in the philosophical basis of the theory of measurement. As to the ether we must consider how little we know about its nature, and it seems premature either flatly to deny its existence, or to affirm doubtful qualities of it, or to make bold *a priori* statements as to its motions with reference to the motions of matter. Here experiments alone, like those made by Professor Michelson, will be decisive. Finally whatever difficulties may still present themselves, we may be assured that all of them will find a satisfactory solution without upsetting the foundations of our scientific world-conception. EDITOR.

THE BOOKS OF PRIMEVAL HISTORY.

[In former numbers of *The Monist* we have published the following philosophical poems of the late Major J. W. Powell: "The Soul," April, 1895; "Becoming," July, 1911; and this third contribution glorying in the ancient records of geology, of the sites of ruined cities and the graves of primitive man, exhibits the same enthusiasm for the results of scientific research as did the former poems for philosophical subjects. We have selected this poem, here published for the first time, from the manuscripts which the author shortly before his death entrusted to the editor.—ED.]

THE STONE BOOK.

The history of primal man is found
In doomsday book of generations dead—
The rock-leaved bible called Geology,
With pages graved in elemental strife,
Where every fossil letter cost a life.

The primal arts were born in every land,
For widely scattered o'er all lands are found
Stone tomahawk and spear and knife and dart—
The cruder vestiges of man's first art.

The culture first expressed in tools of flint
Began in every land, and long ago—
A moment, reckoned right in scale of time,
The geologic dial used by sage,
But told in years of man, an unknown age.

That history in stone, spread o'er the earth,
Whose pagination is in fossil forms,
Records a meager tale of primal man—
That being shared by every lowly brute,
Without the trace of higher attribute.

The time-bleached casket erst that held the brain
Reveals but ill the mind of early man,
For nobler life of proud humanity
Is not expressed in framework osseous
Which petrifies in beds of ooze and clay,
To be exhumed for cabinet display.

Fools dig for bones and measure them by rule,
(Their art ycleped as "anthropology,")
And vainly deem they resurrect the man
In empty cranium of ancient mole
And find a "dolichocephalic" soul.

These primal men of stone-book record lived
In forest, round the sheltered bays of sea,
On shore where wild bird's flight to reedy isle
Was mirrored clear in quiet woodland lake,
On bank where fishes played in purling brook,
Near spring where flower bloomed in quiet nook.

The Eden fair of stone-book men was large.
They could not wander out through polar zones,
For, walled with ice, their Eden was enclosed.
Between these frozen lands, where summer's sun
The verdant hills and waving meadows warmed,
Their garden stretched through all the zones of life.
So all the lands to primal men gave birth—
The universal denizens of earth.

Before they learned stone knives to fashion fair,
Before they learned shell beads and plumes to flaunt,
To build of bough and bark and reed and stone
Their shelters rude from wind and drenching storm,
These men had wandered over every vale
And made their homes in every quiet dale.

These sylvan men and dusky mates of old,
In tribes whose bonds were streams of kindred blood
And cords of love entwined of marriage ties,
Were scattered everywhere throughout the earth
Before the human tongue was skilled in speech,
Before the race had learned the trade of kings
And force of laws and majesty of courts.
They lived in plenty with the crudest arts,
And high emotions kindled not their hearts.

But primal man expressed his thought in art,
And fashioned stocks and stones for simple use,
And slow evolved a lore of mythic life,
And speech for mild or harsh exchange of thought,
Invented social life for help and peace,
And sports for wold illumed by fagot light
That cleft the shadows dense of forest night.

From modern culture back to primal state
These arts are traced in sure converging lines,
The lore becoming more a mythic tale,
The tongue more babbling in simplicity,
The institutions ever found more crude,
The sports more childish in their simple glee—
To trace all this with just fidelity
Is task of truer anthropology.

Song.

Book of the rocks adamantine,
The drama of ocean and land,
Mountain and forest and prairie
And fountain and cataract grand,
Eons of change is your story
While islands of ocean were planned.

Book of the ages unnumbered,
With record of flood and of fire,
Headlands engulfed by the waters,
And seas raging high in their ire,
Eons of earthquakes your story
And mountains on funeral pyre.

Book of biology primal,
Of lives on diversified plan
Blooming in Edens of verdure
Or roaming by kindred and clan,
Eons of life is your story,
With postscript for primitive man.

THE RUIN BOOK.

The vestiges of early homes are found
In wild confusion scattered o'er the earth,
On sites of thorps no longer used by man,
All marked with relics rude and strange and waste,
As tools of flint and potsherds scattered wide,
And mealing stones, and bowls of steatite,
And many a needle made of bone or horn,
And kitchen fragments now in heaps forlorn.

For knife and spear and arrowhead man wrought
The torrent-fashioned boulder of the stream
And dornick quarried from the bank or scaur,
And deftly wrought the stone to cutting edge
With blow of granite hammer wrenched from cliff,
Awhile the spalls were scattered o'er the glebe
With reject forms that fitted not the plan
Of primal, patient, toiling artisan.

Anon the failures found at quarry ledge
Are made to tell of "paleolithic" man;
The finished tools of village site give proof
Of "neolithic" art and puzzled sage.
So, wandering by river bank at work,
The sylvan man belongs to primal age;
But, home returned, is classed in higher stage;
And two mysterious groups of men are found
Whose occult arts bestrew the modern ground.

In humid lands clear tarns reflect the sky,
With sapphire depths and drifting clouds of gray,
While reeds and waterlilies fringe the shore,
Whose creeping roots reluctant share the sands
With driven boles of ash or oak or pine—
Foundation weird of ancient palafitte,
The clustered dwellings reared above the wave,
Where spearman pierced the trout with antler glave.

Lacustrian dwellings now in ruins lie
Beneath the storm-fed, wave-washed sands of time,
To bury many a work of primal art
That now a tale of ancient times impart.

In arid lands, where cliffs and ledges stretch
Athwart the opalescent desert wild,

High mesas stand, as broad foundation built
For pueblo homes in centuries agone,
Whose ruins tell the tale of culture's dawn.

Where stalked the boasting chief the wolf now prowls;
Where danced the tawny maid the raven hops;
Where children nude disported in the sand
The badger digs a home for owl and snake;
In ancient tom-tom halls the bats now screech
And gliding lizard turns its agile head
To gaze on squirrel sporting o'er the dead.

Eternal rivers roll through high plateaus
And cut their channels deep with flinty saws,
Till canyon walls o'erhang the roaring wave,
With buttressed shelves and adamantine floors
And stairways grand to storied halls of cliff,
All carved by artist storms for homes of men,
Primeval wanderers in canyon glen.

These homes have crumbled, cliffs have fallen low,
And stairways grand have yielded unto flood,
And primal arts are buried deep in sand,
To be exhumed for lore of modern land.

In geologic time the earth was rent,
And blast from subterranean furnace poured
A storm of dust athwart the firmament,
In streams pulverulent of pumice stone,
Which fell to earth, awhile new mountains rose,
And round whose summits purple clouds repose.

As storms are marshalled under banner red
Along the craggy battle-field of mount,
The cohorts plunge adown the steep defile

In torrent columns over pumice slope
And open canyon lanes to valley low,
While chalky cliffs are left to mark the way
Of mighty rivers rolling on for aye.

High up these cliffs the ancient man made home
In lodges excavate with maul of trap:
Deep chambers, carved in pumice rock of white—
The cavate dwelling strange of primal knight.

But patient time, who builds the continents
And scatters them again o'er ocean floor,
But smiles at tufa cliffs, and lays them low
In ruined heaps, where buried arts now show.

The vales and plains that gather waters sweet
To feed the crystal streams that pour their floods
In midland sea that rocked the cradle soft
Of early culture, now historical;
The desert valley fed by tawny Nile;
The bulbul vales of Tigris and Euphrate;
The river lands of "Ind and Far Cathay";
The table lands becrowned with mountains huge,
Are all the sites of ancient cities dead,
Whose walls and turrets now are buried deep
And kings and prophets tombed in final sleep.

Then comes the story of Vesuvius,
With cities buried under fiery flood
For many centuries of deep repose.
The all-destroying element of fire,
Its lust for slaughter sate with sacrifice,
A moment paused to make a book of fate,
A history devoid of love and hate.

But more: All over oriental lands
From time to time great cities spread their walls,
Whose ruins slumber deep on fertile plain,
Where rivers flow in haste to join the main.
Their roster vast is book of final doom,
And every rolling hill is but a tomb.

In occidental lands, as ages came,
A thousand thousand villages were built,
To flourish under rule of chief and priest
And be o'erwhelmed by war of man and storm;
Their lengthened roll a scroll of many tongues,
Their history the tale of many tombs,
Their book of wars illumed by clubs and darts,
Their book of deeds illumed by shards of arts.

Song.

Centuries come and centuries go;
Solitude reigns where monarch was crowned,
Battlements crushed and minarets low,
The cities are strewn over desolate ground.

Gone are the years and gone are the folk;
Lost is the tale of opulent life;
Whelmed by the years or whelmed at a stroke,
The cities are gone with their turmoil and strife.

Capitol wrecked, metropolis crushed,
Palace in dust and temple in ash,
Tyrant in tomb and orator hushed,
The cities are gone in the centuries' crash.

THE TOMB BOOK.

The peaks and crags and minarets of mount,
With crimson coronets and golden glow,
Forever and forever doff their crowns
And hide their mourning heads in clouds of woe
As souls depart from life in vale below.

Through many centuries of rolling years
Mankind has marched, around this planet ball,
Adown the broad highway of teeming life
To death's grim portal, open wide to all,
Beyond whose gate there spreads a mystic pall.

And on they course in armies to the gate,
Their greeting e'er a song of joyous tone,
Their farewell e'er a requiem of grief;
From joy to grief the phalanx marches on,
Beyond the pale where multitudes have gone.

Still on they come, adown the sequent years,
With cheer and glee and loud exultant boast,
In tribes and nations pouring down the way,
Forever coming in a mighty host,
Departing ever to the mystic coast.

Beside the cradle way to coming life
Fair Joy forever stands with arms unfurled,
In camis white, resplendent as the day,
Her golden tresses by the breezes curled,
To greet arriving hosts to beauteous world.

Beside the postern way from life to death
Wan Grief forever leads the weeping band.

In trailing robes of sorrow's sable hue
For hosts departing to the unknown strand,
From region filled with light to shadow-land.

Wherever copse of blossom life is spread
Has rocked some cradle watched by mother's eye;
The soft south wind afanning baby cheek,
A low sweet song ahushing baby cry,
And fond caress asoothing baby sigh.

Wherever continents and islands rise
Above the restless wave of boundless main,
There every rood of land is ancient grave;
And round this portal all the weeping train,
With sobbing bosoms, chant the sad refrain.

The lullaby of Joy is never hushed,
The threnody of Grief is ever rife;
But canticle and ululation mix
In weird and dithyrambic hymn of strife
That echoes down the corridors of life.

Alas, pale Death has wandered round the world;
His footprints mark the universal earth;
His trails are meshed in every glade and wood,
And tombs on tombs are piled to dismal height,
And bones with bones in ossuary laid,
And skull by skull in circling ranks displayed.

In mounds were placed the dead of early man,
And multitudes of tumuli were built
In tropic forest, palm grove, cypress wold,
In fiord and glen and stony glacial plain,
And on the sand spit built by stormy main.

That peace might reign they stored beside their dead
The simple wealth acquired by skilless toil,
As garments, weapons, tool of handiwork,
And baskets, vases, ornaments, and toys,
And all the primal store of childish joys.

The customary deed became a rite,
Repeated o'er as sacred gift to love,
Until at last religion sealed it meet
As sacrifice to dear ancestral shade,
An offering to unseen spirit made.

Where flows the Tennessee from mountain founts
In sweeping curves to River Beautiful,
Among magnolia groves of attar rich
And tulip trees whose blossoms strew the ground,
There ancient clustered graves are stone-wrought cists
That hold the last remains of tribes unknown,
Above whose forms the mighty oaks have grown.

On River Green that flows from mountain tarn
To wed the River Grand, whose source is found
Where asters, gentians, and lilies grow,
Whose silent song is melody of light,
There cairns are built above the long-lost dead,
And every native swart who journeys by
Adds stone to stone in pious memory.

Beneath Andean peaks whose summits rise
Above the tide of wide Pacific sea
A sand dune stretches bleak to naked shore,
Where men are tombed in vestments wrought of wool,
The wondrous tapestries of Gobelin,
In weird necropolis of old Ancon,
The city eld by hosts of time o'erthrown.

Where turbid Tiber creeps o'er ancient plain,
Among the ruin vast of elder world,
Past tomb of emperor and tomb of slave,
The hosts of dead are stored in catacomb,
The gloomy subterranean hall of Rome.

Where Kedron's rills roll on, as Jordan rolls,
To fill the Dead Sea vased in Palestine,
Jerusalem the mighty stands to guard
The Sacred Sepulcher where Mary stood
And wept her Lord and Love and Life and Hope.
Anon the armies meet and warfare wage
To win Redeemer's tomb as battle gage.

In Afric highlands, where the mountains rise
To kiss the clouds and woo their welcome snows,
Great rivers flow with waters sweet and pure,
To join where lands are swept with wild simoons
And waves of Nile are stained with drifting dunes.

The Nile-fed desert homed an empire vast,
Once kinged by Pharaohs whom Moses knew,
Who ruled o'er hosts of slaves, the spoils of war.
These weary toilers, urged by tyrant lash,
Wrought mighty blocks from distant granite cliffs,
And built the pyramids as tombs for kings
Who sought through mummied death new life to gain
And wondrous immortality obtain.

Where mighty city stood in ancient time
A mausoleum housed a silent king,
Embalmed and wrapped in vestiges of waste.
Now titles proud and history are lost,
But refuse cerements have a story lore
More highly prized than scripture tomes of yore.

A melancholy book, this tome of tombs,
Whose leaves are scattered over all the earth.
No pinion plucked from wild bird's soaring wing,
And no papyrus from the reedy bank,
No pitchy ink, compound of gum and soot,
Were made to serve the author's unkenned task.
Ah, little dreamed he of the curious lore
He writ in silent sepulcher of yore.

The book of rocks and book of ruins sad
And book of tombs that house the many dead
Are triune tomes of archeology
That tell the tale of long-departed men,
The unremembered folk of years agone,
Whose bards had not the skill of pen and press
To tome their tales in book scriptorial;
But yet in amber deeds their lives were cast,
The prehistoric tribes and nations vast.

Song.

The wind drifts dust on ancient thorp,
And the waves spread their ooze over hamlet of lake;
The wild beast roams where pueblo stood,
And the storm sweeps the sand over cliff-dweller's wake.

The talus tombs the cavate lodge,
And the river engulfs the pantheon proud;
The desert creeps o'er ancient mart,
And the hurricane weaves for the city a shroud.

Volcano dooms Pompeii fair,
And the gates of old Babylon swing nevermore;
Palenque sleeps in tropic wold,
And the Andes are dirging Huanaco of yore.

J. W. POWELL.

CRITICISMS AND DISCUSSIONS.

THE MONISM OF "THE MONIST,"

COMPARED WITH PROFESSOR HAECKEL'S MONISM.

Professor Haeckel is a dear old friend of mine. Though my senior in years he has always been very cordial to me, nor has our friendship been marred in the least by my criticism of his conception of monism.. In fact it was quite impossible to make him reply to my strictures and I found out that it takes two to quarrel. He answered me in his letters and repeated it orally in conversation, "We mean the same," and I am only sorry that he cares so little for the differences to which I attach much importance.

Like Haeckel I accept the scientific world-conception which can only be monistic. I reject like him any kind of dualism, especially spiritism, viz., the belief in the existence of spirit in itself. At the same time I believe in evolution, not only the evolution of animals, but also of mankind, especially of human thought, of science, of religion and religious beliefs and institutions. Religious ideas are not mere fancies or inventions of a fraudulent priesthood; they originated with reference to the realities and the needs of life.

While my friend Haeckel would interpret the God-idea to mean matter and energy, as he said in a letter published in *The Open Court* for September 17, 1891,[1] I insist that the God-idea has always had in its historic development a moral significance. It always stood for justice, righteousness, truth, goodness, etc., and on the ground

[1] Compare also the following articles on Monism: "Professor Haeckel's Monism and the Ideas God and Immortality," *Open Court*, V, 2957-8. Cf. also the author's articles: "Professor Haeckel's Monism," *The Monist*, II, 598, in answer to Haeckel's "Our Monism," *The Monist*, II, 481; "Haeckel's Theses for a Monistic Alliance," *The Monist*, XVI, 120; "Monism, Dualism and Agnosticism," *Open Court*, I, 209; "The Religious Character of Monism," *Open Court*, II, 1381, in reply to "Christianity and Monism" by Dr. Gustav Carus, *Open Court*, II, 1379; "Professor Haeckel's Confession of Faith," *Open Court*, VII, 3528; and Mr. Edward C. Hegeler's article "What the Monistic Religion is to Me," *Open Court*, I, 725.

of this consideration I define God as "the authority of conduct." I claim that we can trace such authority of conduct in our experience and so I declare that it exists; it is a natural law; it is the same law according to which mankind develops higher and ever higher. There is punishment for wrong doing, there is a curse on sin, there is a blessing on righteousness; and the factors in objective reality which cause these results whatever they may be, have been personified and are called God. We can make no mistake in retaining this impressive name as one of the most important terms in our language.

The moral law is ultimately the same law as the totality of all the laws of nature; it is merely the application of the law of cause and effect to social conditions, and this God-conception may fairly well be characterized as nomotheism. God is the lawdom of the world, and by lawdom I understand what the Germans call *Gesetzmässigkeit*. Lawdom is the world's constitution as a law-ordained whole, consistent with itself in all details so as to appear as a system of uniformities. Thus the cosmic order makes the impression as if it were governed by an omniscient and omnipresent ruler, and the obvious efficiency of this intrinsic and immanent order has led to its personification as God. Atheism is wrong when denying with the name God this moral law of the world. Atheism is right only in so far as the constitution of the cosmos is not an individual being such as we poor mortals are, but theism is right when it insists on the objective significance of truth and of right and of all other ideals as a real factor in the formation of mankind. This is a God-conception which the atheist can not deny if he but believes in ideals, moral or scientific or artistic. It is the God-conception of science.

Nomotheism is neither the traditional theism nor is it pantheism, for the God of science is not identical with the All, nor is it a deification of nature. The God of science is neither matter and energy nor the totality of all existent things; it is the law that shapes them, the factor that governs their origin and growth, the eternal norm which determines the destiny of the world as a whole and also in its parts. It is the intrinsic consistency which exists in and by itself and would exist even if nature did not exist, and so it is in the literal sense of the word (though not in the traditional interpretation) supernatural.

It might be well to add that it would be wrong to call the God of science "impersonal" because God is the factor which creates personality, and so God is the condition of personality, and this higher and more scientific conception of God we prefer to call

"superpersonal." God is not less than a human person, he is more. He is the standard and supreme norm of personality.

In the opinion of spiritualists I am perhaps just as much a materialist as Professor Haeckel, but I insist on the paramount significance of what is called spirit, soul, mind, and of all the spiritual values of life. In fact there are no higher values than spiritual ones, and material goods possess value only so far as they are or can become serviceable for spiritual enhancement.

The soul originates in and through brain functions, but it is unsubstantial and non-energetic. The spiritual is constituted by the meaning of the several brain functions, by their significance, and above all by their purpose. Meaning is not made of matter nor does it consist of energy. Meaning is neither brain nor nervous function. It is a mere relation, and one might consider it as non-existent, in the sense that it is not a concrete thing. Meaning is the reference of one thing to another. Meaning originates when certain definite forms of feeling or sensations stand for certain definite realities. From these simple beginnings mind grows.

There is one point that must be emphasized: Form is more important than matter, and the relational of greater consequence than energy. Thus it comes to pass that the spiritual, this significance of brain functions, becomes hyperphysical. Though non-material and non-energetic, it is real, being an efficient factor in moulding things and guiding the affairs of life. Without this meaning of brain functions, without this purpose-pursuing quality of living beings, or as we commonly say, without the spiritual, without the presence of the soul, life would be a senseless jumble, and the world would be a mere chaotic display of physical forces. From this subtle quality of meaning alone rise all the wonders of human aspiration and moral endeavor, all values of life and also our religious and artistic ideals.

I cannot enter here into further details of how on the basis of this monistic conception many important problems find their proper solution. I will note only two: First, man is held responsible for his acts, and the thought of his responsibility enables him to criticize himself, to control and to judge of his several impulses, and to rise beyond his present condition by improving his character. This is practically the meaning of the belief in freedom of will.

Further, evolution means the continued life of former generations, which is an immortality in the race, and presupposes that all of man's most individual tendencies are preserved to serve as a basis for further progress. In the souls of the generations to come there

are many mansions for "those immortal dead who live again in minds made better by their presence" being "the choir invisible whose music is the gladness of the world."

Professor Haeckel thinks that there is a streak of dualism left in my conception of monism, but he is mistaken. He simply fails to understand my use of the words "God," "soul" and "immortality," while in my opinion he has not carried out his monistic principle into a full appreciation of the spiritual values of life. The origin and nature of the soul has to be explained without resorting to dualistic or vitalistic assumptions, and that is the work which I have done.[2] I recognize that the soul is not merely an accidental byplay of the functions of matter, and that in it the universe reveals itself in its full grandeur. Though the soul is not matter and not energy, it is the highest efflorescence of the development of natural forces. Professor Haeckel knows this all very well, but in his writings he shows himself so much the advocate of natural science *versus* superstition that he associates the words "God" and "soul" with a reactionary conception of religious dogmatism. Professor Haeckel ought to realize that a scientific conception of God and soul is possible, for he endorses fully Goethe's God-conception, and sees no dualism in it.

The truth is that there is not only matter and energy, but there are also the relational conditions; there is form, and form is more important than substance. Meaning originates from form, just as differently shaped letters represent the various sounds. There is a similarity or at least a correspondence between the things sensed and the several sensations, and their similarity makes the several sensations represent the several things sensed. Sensations are feelings that have acquired meaning, and from meaning rises the whole domain of spirit.

We must consider that Professor Haeckel is a naturalist, not a philosopher, and he has paid little attention to a consideration of religious questions. Nor is there any harm in this for we can not expect him to be at home everywhere. He was brought up in circles

[2] A condensed statement of my philosophy has appeared in English, German and French under the title *The Philosophy of Science* and an Italian version is in preparation. It explains in the short space of less than fifty pages the most important problems and treats among other topics the following subjects: The foundation of mathematics and logic, cause and reason, organized nature, subject and object, personality and self, the origin of consciousness, preservation of form in the flux of life, memory the soul-builder, truth the measure of man, pleasure and pain, free will, immortality, and the God of science.

of a very narrow-minded conception of an unprogressive protestantism and had much trouble to rid himself of the dualistic errors which placed him from the start in a wrong attitude towards religion. For a long time he was very patient with his antagonists, and it is quite excusable if here and there he goes a little too far. Have not his enemies gone too far in their attacks on him? They have painted him as black as a devil. I need not add that Haeckel's love of truth, his sincerity, his scientific honesty, and the kindliness of his character are genuinely religious.

As to the main point, however, concerning my differences with Professor Haeckel, I feel sure that he agrees with me better than with himself, and I hope he will pardon me for the statement.

EDITOR.

SCHOPENHAUER ON NEWTON AND HOOKE.

[In connecton with Mr. Philip E. B. Jourdain's article on "Robert Hooke as a Precursor of Newton," we venture to publish these extracts from Schopenhauer's writings to call attention to his position with regard to the priority of the discovery of the laws of gravitation between Newton and Hooke. Although some of the details may be inaccurate, Schopenhauer often hits the nail on the head. It cannot be denied that indirectly or directly, Hooke provided a great stimulus for Newton.—ED.]

In order to appreciate the great value of the gravitation theory which Newton perfected, to say the least, and placed on a positive foundation, we must recall the state of perplexity in which thinkers had been for millenniums with regard to the movements of the celestial bodies. Aristotle represented the universe as composed of transparent concentric spheres, the outermost of which contained the fixed stars, each of the succeeding ones a planet, and the last the moon; the nucleus of the machine was the earth. Now, what the power was that kept this system constantly in rotation was a question to which he had nothing to say except that there must be a *πρῶτον κινοῦν* somewhere—and this answer men have since been so kind as to interpret as theism, whereas he did not teach the existence of a creative God, certainly not that the universe is eternal, and barely a first motive energy in his cosmology. But even after Copernicus had replaced that fabulous construction of the world-machine by the correct one, and also after Kepler had discovered the laws of its motion, there still remained the old perplexity with regard to the motive force. Aristotle had assigned to the spheres

an equal number of gods for their direction. The scholastics transferred this direction to certain so-called "intelligences," which is simply a more pretentious name for the good angels each of which now drove its own planet. Free thinkers like Giordano Bruno and Vanini later knew no better than to make the planets themselves a sort of living divinities. They were followed by Descartes who always tried to account for everything in a mechanical way, but could conceive of no other motive energy than impact. Accordingly he assumed an invisible and intangible substance which surrounded the sun in layers and pushed the planets forward, the Cartesian vortex.

How childish and trivial all this is, and how much therefore we ought to value a theory of gravitation which has demonstrated incontestably the motive causes and the forces effective in them, and this so positively and accurately that even the slightest deviation and irregularity, acceleration and retardation, in the course of a planet or satellite can be perfectly explained and exactly computed from its nearest cause!

Hence the fundamental notion of making gravitation, which is known to us directly only as weight, the controlling force of the planetary system, is such a supremely significant one because of the important consequences following upon it that an inquiry with regard to its origin deserves not to be set aside as irrelevant; especially as we ought to strive to judge correctly at least as posterity, since we are so seldom able to do so as contemporaries.

It is well known that in 1686[1] when Newton published his *Principia* Robert Hooke raised a hue and cry about his priority in its main contention; and also that the bitter complaints of himself and others forced from Newton the promise to mention them in the first complete edition of the *Principia* (1687), which he did with the fewest possible words in a scholium to Book I, prop. 4, cor. 6, in the parenthesis, *"ut seorsum collegerunt etiam nostrates Wrennus, Hookius et Hallaeus."*

[1] The *Principia* was not published until the next year and there seems to be no evidence that any one but Newton and Halley saw the proof sheets in 1686 although it is possible that Halley showed them to his acquaintances. In April 1686 Halley announced to the Royal Society that the *Principia* was almost ready for the press, and soon afterwards the manuscript of the *first Book* was presented to the Society. The book was licensed to be printed in July, 1686 (the "Imprimatur" was signed on July 5). Printing was begun just before this, and the first sheet in proof was sent to Newton on June 7, 1686. The second Book of the *Principia* was not sent up for printing until March, 1687, and the third shortly after this. The complete work was published in the midsummer of 1687.

That in the year 1666 Hooke had already propounded the essential part of the gravitation theory (though simply as an hypothesis) in a "Communication to the Royal Society" we can see from the main passage of this treatise which is reprinted in Hooke's own words in Dugald Stewart's *Philosophy of the Human Mind,* II, p. 434. In the *Quarterly Review* of August 1828 there is a good concise history of astronomy which treats Hooke's priority as an established fact.

In Michaud's *Biographie universelle,* comprising about one hundred volumes, the article "Newton" seems to be a translation from the *Biographia Britannica* to which it refers. It contains the representation of the universe according to the law of gravitation literally and *in extenso* according to Robert Hooke's *An Attempt to Prove the Motion of the Earth from Observations,* London, 1674, 4o. The article further states that the main point, namely that gravitation extends to all the celestial bodies, had already been expressed in Borelli's *Theoria motus planetarum e causis physicis deducta,* Florence, 1666. Finally it gives Newton's long reply to Hooke's above-mentioned claim to the priority of discovery.

On the other hand the apple story which has been repeated *ad nauseam* is without foundation. It is first mentioned as a well-known fact in Turnor's *History of Grantham,* p. 160. Pemberton, it is true, who knew Newton personally, although only after he had become old and infirm, relates in the preface to his *View of Newton's Philosophy,* that the thought first occurred to Newton in a garden, but says nothing about the apple; this was a later plausible addition. Voltaire claims to have heard it orally from Newton's niece, which is probably the origin of the story. See Voltaire, *Elémens de philosophie de Neuton,* II, chap. 3. A note to Byron's *Don Juan* (Canto X, stanza 1) says: "The celebrated apple-tree, the fall of one of the apples of which is said to have turned the attention of Newton to the subject of gravity, was destroyed by wind about four years ago. The anecdote of the falling apple is mentioned neither by Dr. Stukeley nor by Mr. Conduitt, so, as I have not been able to find any authority for it whatever, I did not feel myself at liberty to use it.—Brewster's *Life of Newton,* p. 344."

To all these authorities contradicting the assumption that the great conception of universal gravitation is a brother to the fundamentally false theory of homogeneous light, I have one more argument to add, which to be sure is only a psychological one, but will

have considerable weight for those who know human nature also from its intellectual side.

It is a well-known and undisputed fact that Newton at a very early period, it is said as early as 1666, either of his own accord or with outside aid, had conceived the theory of gravitation and sought to verify it by applying it to the orbit of the moon; that nevertheless, because the result did not exactly agree with the hypothesis, he finally let the latter drop and abandoned the subject for many years. Equally well known is the cause of the discrepancy which frightened him away. It arose simply from the fact that Newton took the distance of the moon from the earth as almost 1/7 too small, and this again because the distance can be first measured only in diameters of the earth; the diameter of the earth is computed from the length of the degrees of the circumference of the earth, and only these latter can be measured directly. Now Newton used the degree merely in its common geographical acceptation as containing 60 English miles in round numbers, whereas in fact it has 69½. The result was that the orbit of the moon did not agree with the hypothesis that gravitation is a force decreasing according to the square of the distance. Hence it was for this reason that Newton gave up the hypothesis and dismissed it. Not until about sixteen years later, that is, in 1682, did he learn of the measurement of degrees, completed by the Frenchman Picard some years previously, according to which the degree was almost 1/7 larger than he had formerly supposed it to be. Without considering this of much importance he made a note of it in the Royal Society where it was communicated to him from a letter, and then proceeded to listen attentively to the lecture without being at all disturbed by the fact. Not until afterwards did the old hypothesis occur to him. He again took up his calculations with regard to it and now found the state of things to correspond to it exactly, whereupon he fell into great ecstasies, as everybody knows.

Now I ask every one who is himself a father, who has himself begotten hypotheses, who has fed them and nursed them, does a man thus treat his own children? When everything does not go just right, does he at once thrust them out of the house without mercy, slam the door shut, and not ask a word about them for sixteen years? Would he not much more likely in a case like the present, before pronouncing such a bitter "There's nothing in it," suppose the mistake to be anywhere, even in the creation of the Heavenly Father himself if need be, sooner than in his own beloved child that he had

brought into life and carefully cherished?—and especially in just that point where suspicion might so easily have found its rightful place, namely in the only empirical datum (besides the one angle) upon which the calculation was based, and whose uncertainty was so well known that the French had been carrying on their degree measurements since 1669, in spite of which uncertainty Newton nevertheless had made his assumption according to the popular acceptation in English miles. And a man could be so misled with a true and elucidating cosmic hypothesis? Never, *if it were his own*! On the other hand, I can tell you likewise what children are treated in this way: foundlings who are taken reluctantly into the home, at whom (on the arm of his own barren wife) the man looks askance with envious eyes and puts to a test only from a sense of duty, hoping they will not stand the test, and as soon as this is confirmed throws them out of the house with jeers of ridicule.

This argument is of such great importance, at least to me, that I recognize in it a complete corroboration of the evidence which ascribes the fundamental conception of gravitation to Hooke and leaves to Newton only its verification by calculations. According to this view Hooke has fared as badly as Columbus: the continent is called "America," and gravitation is called "Newton's theory."—*Parerga und Paralipomena,* II, Section 86.

* * *

No science imposes upon the multitude so much as astronomy. Accordingly the astronomers who for the most part are ready reckoners of very ordinary capacity, put on great airs with their "most exalted science" and similar expressions. Even Plato joked about these claims and called to mind that what is exalted is not necessarily that which happens to be above us (Rep. L. VII).

The almost idolatrous veneration which Newton enjoys, especially in England, exceeds all belief. Just recently he was called in the *Times* "the greatest of human beings," and in another article in the same journal an attempt is made to console us with the information that we may feel assured that he nevertheless was only a man! In the year 1815 (according to the report of the weekly *Examiner*, printed in *Galignani,* Jan. 11, 1853) one of Newton's teeth was sold for 730 pounds sterling to a lord who had it set in a ring, which tale reminds us of the sacred tooth of Buddha. Now this ridiculous adoration of the great master of calculation rests on the fact that people take as the measure of his merits the size of

the masses whose movements he has reduced to their laws and these to the force of nature therein operative (which latter, moreover, was not his discovery but Robert Hooke's which he merely confirmed by calculation). Otherwise we cannot see why more honor is due him than to any other who has reduced given effects to the expression of a definite force of nature, and why, for instance, Lavoisier should not be valued as highly.—*Parerga und Paralipomena,* II, Section 80.

* * *

Hooke's discovery of the law of gravitation, and the reference of so many important phenomena to this one law, was the work of immediate apprehension by the understanding; and such also was the proof of Newton's calculations, and Lavoisier's discovery of acids and their important function in nature, and also Goethe's discovery of the origin of physical colors.—*World as Will and Idea* (ed. Haldane and Kemp), I, 26.

* * *

It cannot but disturb us very much if we find minds of the first order under suspicion of dishonesty, which would be a scandal to those of the lowest order. For we feel that theft is even more inexcusable in a rich man than in a poor one. We dare not, however, be silent; for here we are posterity, and must be just, as we hope that posterity will be some day to us. Therefore, as a third example,[2] I will add to these cases, that the fundamental thoughts of the "Metamorphosis of Plants" by Goethe, were already expressed by Kaspar Wolff in 1764 in his *Theory of Generation,* pp. 148, 229, 243, etc. Indeed, is it otherwise with the system of gravitation? The discovery of this is always ascribed to Newton on the continent of Europe, while in England the learned at least know very well that it belongs to Robert Hooke, who in the year 1666, in a communication to the Royal Society expounds it quite distinctly, although only as a hypothesis and without proof. The principal passage of this communication is quoted in Dugald Stewart's *Philosophy of the Human Mind,* and is probably taken from Robert Hooke's *Posthumous Works.*[3] The history of the matter, and how Newton got into difficulty by it, is also to be found in the *Biographie universelle,* article "Newton." Hooke's priority is treated as an established fact in a short history of astronomy in the *Quarterly*

[2] The first was Kant's dynamics previously expounded by Priestley; the second was Laplace preceded by Kant.—Ed.

[3] See Mr. Jourdain's article on another page.

Review, August, 1828. Further details on this subject are to be found in my *Parerga,* Vol. II, Section 86 (second edition, Section 88). The story of the fall of an apple is a fable as groundless as it is popular, and is quite without authority."—*World as Will and Idea* (ed. Haldane and Kemp), II, 225-226.

EARLIER THEORIES OF GRAVITY.

It is universally conceded that gravitation is the most incomprehensible of all forces. Gravitation is supposed to be included in the law of conservation of energy, and from one point of view there is doubtless evidence to show this. When a body is poised upon the edge of a table, let us say, it possesses a certain amount of potential energy. When that body falls to the ground, its potential is converted into actual or kinetic energy. The energy is therefore released from the body which now possesses none. The energy it once possessed has been expended and converted into the work of the world, or its energy has been radiated uselessly into space; and thus we see how gravitation, the attraction of the earth for all material bodies, can be made to enter into the circle of generally recognized forces and included in the law of conservation. It might be questioned whether potential energy *is* energy in the strictest sense of the term, but I shall let that pass for the moment and assume that these facts prove what they are said to prove.

Gravitation is certainly the most mysterious of all known forces, and even yet nothing definite can be said as to its *modus operandi.* In the case of all other forces known to us it is possible to shut off their influence, to find some body which is opaque to their power. Take, for instance, light and electricity. Roughly speaking, glass permits the passage through it of light rays but prevents the passage of electric rays. Steel on the contrary, being a good conductor, permits the passage through it of the electric current but is impervious to light. The same is true of all other forces with the single exception of gravitation. No body has been found opaque to gravitation. It seems to exert its influence above, below, and equally upon all sides of any object. The introduction of a solid sheet of metal, of glass, or of any substance whatever, seems to have no appreciable effect. The body beneath which it is introduced seems to be attracted to the earth by gravitation just as strongly as it was before the introduction of such a sheet. And yet, from all that we know of force and energy, such should not be the case! We are

confronted by an insoluble mystery. What is the nature of this force? How can it be conceived to act? What speculations have been advanced by men in the past to account for this mysterious phenomenon which has so puzzled the world since Newton's first famous experiments?

It is interesting to note that Newton himself speculated on this subject, and some years before arriving at his great generalization he threw out a suggestion as to the cause of terrestrial gravity in a letter to Boyle. In view of the recent experiments performed by the Cambridge school in England, by Dr. Gustav Le Bon and others in France, and by various other scientists—demonstrating apparently, that matter is resolvable into ether, or a mode of energy within the ether—the following extract from his letter shows remarkable foresight upon his part and deserves preservation. Writing in January 1678, Newton thus unfolded his hypothesis:

"First, it is to be supposed that there is an etherial medium, much of the same constitution as air, but far rarer, subtler, and more strongly elastic, but it is not to be supposed that this medium is of one uniform matter, but composed partly of the main phlegmatic body of the ether, partly of other various etherial spirits, much after the manner that air is compounded of the phlegmatic body of air, intermixed with various vapors and exhalations; for the electric and magnetic effluvia, and the gravitating principle seem to argue such variety. Perhaps the whole frame of nature may be nothing but various contextures of some certain etherial spirits or vapors, condensed as it were by precipitation, much after the manner that vapors are condensed into water.... *Thus, perhaps, may all things be originated from ether.*"

Newton's own theory of gravitation he formulated thus:

"I will suppose ether to consist of parts differing from one another in subtlety of indefinite degrees, in such a manner that from the top of the air to the surface of the earth, and again from the surface of the earth to the center thereof, the ether is insensibly finer and finer. Imagine now any body suspended in the air, or lying on the earth, and the ether, being by the hypothesis grosser in the pores which are in the upper parts of the body than in those which are in the lower parts, and that grosser ether being less apt to be lodged in those pores than the finer ether below, it will endeavor to get out, and give way to the finer ether below, which cannot be, without the bodies descending to make room above for it to go into....From this supposed gradual subtlety of the parts of the

ether, some things above might be further illustrated and made more intelligible."

It is well to bear in mind that every hypothesis which attempts to explain gravity is required *in limine* to give a satisfactory account of the following six characteristics of this mysterious influence:

1. Its direction is radical toward the acting mass, or rectilinear —indefinitely. This rectilinear traction is incapable of deflection by any intermediate force. It suffers neither disturbance nor interference from any multiplication of similar lines of action, and admits neither of reflection, refraction, nor of composition.

2. Its quantity is exactly proportional to the acting mass—indefinitely.

Corollary: Hence its integrity of action is complete with every accumulation of additional demand—indefinitely; this is to say, no multiplication of duty in the slightest degree impairs its previous tensions.

3. Its intensity is diminished by recession, in proportion to the square of the distance through which it acts—indefinitely; in a manner somewhat analogous to—but (as modified by the second condition) radically different from—the action of light.

4. Its time of action is instantaneous throughout all ascertained distances, and therefore, presumably,—indefinitely.

Corollary: Hence its rate of action, (if the expression may be tolerated) is precisely the same on bodies at all velocities—indefinitely. It no more lags on a comet approaching the sun at the speed of two hundred miles or more per second than on a body at the lowest rate of motion, or than on the same comet receding from the sun at the same velocity.

5. Its quality is invariable under all circumstances—indefinitely. It is entirely unaffected by the interposition of any material screen, whatever its character or extent; or, in other words, it can neither be checked by an insulator nor retarded by any obstruction.

6. Its energy is unchangeable in time, certainly for the past two thousand years; presumably—indefinitely.

Corollary: Hence, its activity is incessant and inexhaustible—indefinitely; the ceaseless fall of planets from their tangential impulses involving no dynamic expenditure in the sun or in other known matter.

Let us now give a rapid summary of the theories that have been advanced from time to time to explain this mysterious force. Arago, in his *Popular Astronomy*, attempted to show that gravitation trav-

eled with fifty million times the velocity of light, and that the time required to reach us from the nearest star would be about two seconds. Philippe Villemot, a French doctor of theology and a distinguished mathematician, advanced a theory in 1707 that gravitation is occasioned by a difference of pressure on the outer and inner faces of the fluid constituting the solar vortex, owing to an increase of its density outward from the sun. The general conception is obviously somewhat similar to Newton's speculation hazarded in 1678. The next attempt at a solution was offered by Bernoulli, of Switzerland, who attempted to show that gravitation of the planets toward the center of the sun, and the weight of bodies towards the center of the earth, were caused by the immediate impulsion of a substance which he termed "the central torrent." This was continually thrown from the whole circumference of the vortex to its center, and consequently impressions on all bodies encountered by it in its path imparted to them the same tendency towards the center of the vortex.

Lesage, in 1750, was the next philosopher to advance a definite theory of gravitation. To quote Arago's exposition of the theory, it was as follows:

"A single body placed in the midst of such an ocean of moving corpuscles would remain at rest, since it would be equally impelled in every direction. On the other hand, two bodies ought to advance towards each other since they would form a mutual screen, as their opposed surfaces would no longer be hit by the ultra-mundane corpuscles in the direction of the line joining them, and there would then exist currents whose effect would no longer be neutralized by opposite currents. Moreover, it will readily be seen that two bodies plunged into such a "gravitation fluid" would tend to approach each other with a force varying inversely as the square of the distance."

While this theory finds some support from facts known to science, and has even been called "the only plausible answer to this great problem which has yet been propounded," yet the theory utterly fails to acount for many of the known facts, and seems to be in contradiction to others. All that can be said for it is that, unlike most other theories of gravitation, it is at least conceivable and has some faint beginnings of scientific precision.

Leonard Euler, a Swiss mathematician and philosopher, published in 1760 a treatise in which he commented on the action of gravitation as follows:

"Supposing a hole made in the earth through its center; it is

clear that a body at the very center must entirely lose its gravity, as it could no longer move in any direction whatever, all gravity tending continually toward the center of the earth. Since then a body has no longer gravity at the center of the earth, it will follow that in descending to this center its gravity would have gradually diminished; and we accordingly conclude that a body, penetrating into the bowels of the earth, loses its gravity in proportion as it approaches the center. It is evident, then, that neither the intensity nor the direction of gravity is a consequence from the nature of any body, as not only its intensity is variable but likewise its direction, which on passing to the antipodes becomes quite contrary."

Herapath next, in 1816, published an essay "On the Physical Properties of Gases." He attempted to show that there was "one cause for heat, light, gravitation, electricity, cohesion, aërial repulsion, etc., from which all these flow, and are deducible; and their effects may be computed by mathematical induction [deduction?]. It shows us that gravitation, cohesion, and affinity are but the same thing under different modifications; that the differences of the two latter arise from a difference in the figures and sizes only of the particles; that attraction and repulsion are not properties of matter."

Herapath contended that, by noting the continued and mutual condition of particles of gases in the containing vessels, and by extending the principle to the planets, which he supposed to be all of the same density as the earth, he attempted to show that it was possible to calculate the amount of gravity of varied bodies, one toward another. There were of course several fundamental defects in his theory, so obvious that they need hardly be mentioned. The known dissimilarity of the composition of stellar bodies, and the fallacy that any pressure-differences would result from temperature-differences, naturally vitiated his whole argument.

The next ingenious attack upon the problem was made by Guyot in 1861 in an essay entitled "A Sympathetic Glance at the Form and Forces of Matter." Still maintaining that all the properties of bodies are derivatives of their vibratory movements, and that the equilibrium and the phenomena of the world exist only under the condition of constant pressure of the ether upon coercible matter and the reaction of the latter upon the former, he argues that "if it be shown that the vibration of the atoms of bodies may and actually does cause the rarefaction in the sphere of activity of each of the atoms," this constitutes a proof that "the approximation of the atoms of bodies of ponderable matter is due to the rarefaction

of the imponderable fluid, and consequently to the diminution of its pressure in the space between the atoms of the same body"; and hence that "we are compelled to admit that attraction is a mechanical force, consisting first of the rarefaction of the ether between molecules, masses, or the heavenly bodies, resulting from the ceaseless vibration of the atoms of ponderable matter; and secondly of the reaction from the exterior pressure of the ether upon the same, resulting from the general pressure of the imponderable universal medium which constitutes the *mother-liquor* of the world."

In 1844 Faraday issued a speculation on the nature of matter in which his first unformed views were stated. This was followed in 1850 by a memoir on the possible relation of gravity to electricity, in which he stated his belief that there was such a definite connection, though he could give no proof of it. Several years later in a memoir on "The Conservation of Force" he gave the results of his further meditations on "the attractive theme of gravitation." They were these:

"It is a simple attractive force, exerted between any two or all the particles or masses of matter at every sensible distance, but with a strength bearing inversely as the square of the distance.... For my own part, many considerations urge my mind toward the idea of a cause of gravity which is not resident in the particles of matter, merely, but constantly in them and all space. I would much rather incline to believe that bodies affecting each other by gravitation act by lines of force of definite amount or by an ether pervading all parts of space, than admit that the conservation of force could be dispensed with."

On no subject, perhaps, have the distinguished author's ideas been more vague and intangible than on this.

The next speculations of note are those by Seguin, submitted to the French Academy of Sciences in 1848 and 1858. In his earlier writings he held to a crude kinetic theory, founded upon the laws of cohesion, repulsion, attraction, etc. In 1858, however, Seguin published in the *Cosmos* a somewhat elaborate essay on the origin and propagation of force, in which he seems to have abandoned the kinetic theory of gravitation. It is true that he there holds that "matter is inert; that is to say it does not harbor in itself the power to put itself into movement, and still less, *a fortiori*, to communicate it, since a thing to be transmitted must first exist." And it is also true that he repeatedly speaks of "the great principle of infinite conservation of motion" as being the foundation of all mechan-

ics, and regards the possibility of destruction of motion as equivalent to annihilation of force.

Notwithstanding all this, he says in regard to the uniform tendency of a material system towards its center of gravity:

"We are thus led to consider attraction as a first cause, emanating directly from the Divine Will in the creation of matter. Doubtless, it is not impossible that it may hereafter be discovered that attraction in its turn is only a consequence of a more general law, comprehending in itself more implicitly the means of explaining the effects attributed to attraction....But as these considerations are purely metaphysical since observation cannot reach beyond the established fact that two confronting bodies gravitate toward each other by virtue of a force to which is given the name of 'attraction,' it appears to me wiser not to advance further to penetrate a mystery which nothing within our knowledge as yet appears able to explain. Let us then consider matter as existing from the beginning, uniformly in space, and attraction as an essential property with which it is endowed, by virtue of which the different parts or molecules composing it possess in themselves the power of mutual attraction."

M. de Boucheporn read a memoir to the French Academy of Sciences, July 30, 1849, in which he attempted to explain the general laws of gravitation. It was based on the idea that the movements of the heavenly bodies might be explained by an external impulsion, or by the action of a universal fluid. He pointed out first, that the intensity of the impulse propagated in the etherial medium follows the law of the inverse square of the distance from the center of disturbance; second, that the resistance of the ether does not sensibly effect the velocity of a body when this is sufficiently less than that of the theory of propagation; third, that taking the density of the fluid as unity, the quantity of motion impressed by a body on the ether is equal to its volume multiplied by the square of its velocity; fourth, that the pressure would produce the effect that all layers of equal thickness would include the same quantity of matter if propagated to the interior of the heavenly bodies, and that the mean density is three times that of the surface; "fifth, as to attraction, the displacement of the ether by the movement of a body, A, will produce in all parts of the fluid a sort of aspiration toward the point being left by its center; and any body, B, receiving these aspiring waves on its nearer hemisphere, will have lost all or a part of its own pressure, and the half pressure (volume multiplied by the square velocity) which acts on the opposite hemisphere, no

longer being counterbalanced, will give an impulse to the body B, in the direction of A. Such would be the principle of attraction."

In a learned work on elasticity, Gabriel Lamé, in 1852, next attacked the problem of gravitation. He insisted on the necessity for admitting an all-pervading ether. Having theoretically proved its existence, he contends that it is scarcely to be doubted that in the intervention of the ether is to be found the secret or true cause of the effects which are attributed to heat, to electricity, to magnetism, to universal attraction, to cohesion, to chemical affinities. For all these mysterious and incomprehensible agencies are at bottom but coordinating hypotheses.

In 1858 J. J. Waterston, of Edinburg, published an essay entitled "On the Integral of Gravitation, and its Consequence with Reference to the Measure and Transfer or Communication of Force." He contended that "a force-generating faculty exists in space and is directed centripetally. The mutual gravitation of two bodies," he said, "develops mechanical force in each of them, inversely proportioned to its mass." The theory is really very indefinite throughout, since he appears to make gravitation a function of space, being the content of space, or the dynamic medium supposed to occupy it. It may be said that his speculations have failed to find corroboration.

Prof. James Challis, in 1859, published a series of communications beginning with his mathematical theory of attractive forces, and following it through in other papers on "Force," and "Gravitation." He found the theories of elasticity, cohesion, attraction and repulsion in matter insufficient to account for the facts, and was forced back upon the ether. "Yet," he says, rightly enough, "as it is contrary to principle to ascribe elasticity to atomic matter, the question might arise, why is it more proper to ascribe this occult property to the ether?" Concluding that we cannot, he stated his conviction that "we must conceive *another form of ether,* having the same relation to the first as that has to air." In 1876 this author returned to a discussion of the problem. In dealing with the residual effect of vibration, which, he said, "is the attraction of gravity," he says:

"This result expresses the force of gravity as due to the attractive action of a molecule of a higher order as to magnitude than the molecule of molecular attraction. For distinction, a molecule of this superior order might be called a gravity-molecule. Its magnitude may still be considered to be so small that in comparison with

the magnitudes of terrestrial and cosmical masses, it may be treated as an infinitesimal quantity....Lastly, it is to be noted that on account of the large value of λ for gravity-waves they do not suffer sensible retardation or refraction in passing through gross bodies. I have on several previous occasions treated of the problem of gravitating force theoretically, and by slow steps have approximated to its solution; but before the present attempt I had not succeeded in exhibiting satisfactorily the *rationale* of this kind of attraction by vibrations."

In 1861, Mr. J. S. Glennie published in *The Philosophical Magazine* several papers on the subject of gravitation. Summarizing his own views in later articles, Mr. Glennie thus recapitulates and states the substance of his theory:

"Matter is conceived to be made up, not of an elastic ether and inelastic atoms, but of elastic molecules of different orders as to size and density. If a rough physical conception of these molecules be required, they may be conceived as etherial nuclei, the ether of the nuclei of a lower, being made up of nuclei of a higher, order, and so on *ad infinitum*."

Mr. Glennie postulated a universal repulsion, varying through various intensities, instead of universal attraction; but, could it be discussed in detail, it must be said that his theory completely fails to be convincing.

Keller in 1863, Tait in 1864, and Saigey in 1866, all offered speculations upon this subject, based more or less on their theory of force. Saigey went so far as to say that bodies do not owe their gravity to an intrinsic force, but to the pressure of the medium in which they are immersed. Why this pressure should vary at various points in the universe is not stated.

In a communication to *The Philosophical Magazine* in 1867, Mr. James Croll revived the difficulties that had been stated by Faraday and attempted to solve them. He was first of all led to the conclusion that there must be, in order to account for the facts, a destruction of force in one place and a creation of force in another. Finding, however, that this ran counter to the law of conservation of energy, he gave up that attempt and attacked the problem in a different direction. Discussing it from the point of view of the law of conservation of energy, he pointed out that if gravity be correlated to other forms of energy, it must be included in the law of conservation. But here he was met with difficulties. Admitting that gravity can perform mechanical work, and mechanical work can

be converted into other forms of energy, he yet pointed out that it is generally denied that there is a decrease or loss of gravity resulting from such transformations, that is, the body did work without losing any of its force of gravity. It would therefore appear to be outside the law of conservation. After much theoretical discussion, Mr. Croll arrived at the following conclusion: That gravity is in all probability of the nature of an impact or pressure. Finding he could not account for it either on the theory that it resulted from the impact of corpuscles or from the difference in pressure of a substance filling space, he was forced to the conclusion that it was some kind of "pure force."

In 1869, P. Leray published an essay entitled "A New Theory of Gravitation." In this he postulated first, the existence of an ether; second, that at every point there exist equal currents crossing each other in all directions; third, that in passing through bodies the currents of the ether are retarded proportionately to the thickness traversed and to the mean density of the path. In the same year Boisbaudran published a short paper entitled "A Note on the Theory of Weight." His conclusion was: "It is to the longitudinal vibrations of the ether that I attribute the cause of weight." Guthrie in 1870 published an account of some experiments entitled, "On Approach Caused by Vibration." His hypothesis practically made gravitation a function of temperature, which was of course, contrary to all observation.

Sir William Crookes in 1873 offered some speculations in which he pointed out the possible influence of the energy of light-waves as effecting the results, but his statements at that time were little more than restatements of the difficulties, and he had no positive theory of his own to offer.

Lord Kelvin, in his essay "On Ether and Gravitational Matter Through Infinite Space," in 1901 said: "The potential energy of gravitation may be in reality the ultimate created antecedent of all the motion, heat, and light at present in the universe." It will be observed that his definition is really vague and does not attempt to tell us what the *kinetic* energy of gravitation may be. Speculations have also been advanced on this subject by the Cambridge school, by Sir Oliver Lodge, Dr. Gustav Le Bon, and others. It is hardly necessary to say, however, that their articles have consisted almost entirely of accounts of the difficulties to be faced by any theory advanced, and but little has been offered by way of positive theory.

It may be said that the newer discoveries in physics have had

a double bearing upon this problem. The experiments carried on of late years may, perhaps, have furnished us with the first outlines of a possible reconstruction; a comprehension of the facts. On the other hand, they have made the phenomena more mysterious than ever! Gravity has no appreciable action on electricity, while it is the sole reason of the laws governing the flow of liquids. Nevertheless, it more nearly resembles electricity than any force we know. As Dr. Le Bon said in his *Evolution of Forces*: "One gets clearer and clearer glimpses that weight is due to the relations between the ether and matter, connected, doubtless, by lines of force; but this is only a more or less vague hint, which still escapes the teachings of experiment. It is possible that the gyratory movement of the atoms are communicated to the ether and through it to the different material bodies, thereby establishing an attraction between them. The reciprocal attraction of vortices has, at the present day, been demonstrated by many experiments....Gravitation displays the incomprehensible characteristic, which no other manifestation of energy possesses, of not being arrested by any obstacle. The most delicate researches have shown that no body exists which is opaque to gravitation. Gravitation is a very small force if we consider only the action of the masses we have at our disposal, but it is a force extremely great for considerable masses. This power is apparent to us every day in the phenomenon of the tides. Under the influence of the combined motion of the sun and moon, the seas are raised to an average height of one meter, which represents a weight of one thousand kilogrammes per surface-meter.

"Physicists have been able to say nothing more on gravitation than what is said above. In an important memoir of which I reproduce a few passages, Prof. Vernon Boys has shown perfectly how inexplicable it remains. 'It seems to defy,' he says, 'all our attempts to abandon the inconceivable idea of action at a distance; for even when we might conceive another mode of action it is entirely incomprehensible that gravitation should act at a distance without regard to the existence or nature of bodies in its path, and, as it appears, instantaneously....The speed of the propagation of gravitation was estimated by Laplace as being immensely higher than that of light. Henri Poincaré considered it as propagated with a velocity of the order of that of light vibration. We do not know how gravitation is propagated, but it seems to me that the law of the inverse square of the distance allows us to imagine gravitic waves having a form analogous to that of the waves of light, electric

waves, etc.....When a force decreases with the distance in accordance with this law, it is legitimate enough to imagine that it is propagated by spherical waves. This should be the case with gravitation."

So long ago as 1876, Mr. William B. Taylor, in his valuable essay on gravitation, pointed out the difficulties in the various theories that had been advanced by way of explanation. The corpuscular theory, even in his time, he regarded as finally and conclusively disproved. The hypothesis of undulations he regarded as equally impossible. He pointed out that such undulations as had thus far been established were quite incapable of inducing anything in the slightest degree analogous to gravitation, and that the new species of undulation necessary for the theory have never been proved. Great as is the credit due to Professor Challis, for instance, for his laborious efforts to develop this theory by the stern logic of mathematics, the whole demonstration is vitiated by the unwarranted preliminary assumption of qualities and modes of action in the ether analogous to those of gases; but experiment has failed to demonstrate any such similarity. Even if the undulation postulated were proved it would be entirely inadequate to account for the facts. The experiments of Guyot and Guthrie quite conclusively show that neither in the law of quantity nor in the law of intensity can gaseous vibrations represent even approximately the ascertained facts of gravitation embodied in the general propositions. The difficulties presented by inertia, elasticity, etc., have likewise never been overcome.

Failing thus at every point, the hypothesis leaves still more inscrutable the *origin* of the undulation. The center of disturbance is supposed to be the vibrating material element; but the *cause* of the vibration is never stated. If "innate tendency" be the answer, never surely was a more mysterious "occult quality" attributed to matter in the history of physics. Force cannot originate without an originator. The new discoveries in physics have thrown an entirely different light over this problem, causing us to reconstruct our views as to the nature of matter and energy, and their interrelation. Matter, in fact, has been resolved into energy and springs from it. We have the universe traced back to a homogeneous primal ether in rest. Once this ether receives an initial impulse, then all the rest would follow—etherial vibrations, electric atoms, material atoms, worlds, the universe! And into ether all shall return! What caused that prime initial impulse? That we cannot say. Science says that "forces unknown to us" caused it to emerge. It is possible to con-

ceive that this first grand impulse was none other than some human or divine Will.

Nevertheless, granting a prime mover—the immediate operation of a demi-urgus, if necessary—the difficulty would still remain: How is the initial impulse converted into vibration? What is the resisting power deflecting the element in motion from that rectilinear direction which is the first law of action? Upon that subject there is a very remarkable reticence. Is the universe a perpetual motion machine?

There is no reason whatever to believe that the ether is a *source* of energy. We have no experience of any undulations originating in its broad expanse. It is never self-luminous; and even in the case of electricity there is always required the disturbance of a material element. Nor it there any ascertained fact to warrant the supposition that the ether is a *reservoir* of force, in any other sense than that, without the possession of intrinsic tension, it would be incapable of transmitting energy (I am using the terms "matter" and "force" here as they are commonly understood). There is a great deal of loose speculation current regarding the nature of this supposed ether. Dr. A. Rabagliati, in his introduction to my *Vitality, Fasting and Nutrition,* called attention to this, and said: "But what is this ether? M. Le Bon tells us, or at least suggests to us, that it is a solid without density or weight. Some scientists indeed suggest to us that the ether has density and no weight, while others say that it has weight and no density! These are the men, be it observed, who speak somewhat disparagingly of 'purely metaphysical considerations.' They deduce their conclusions from 'experiments.' But are not the definitions purely metaphysical? And are they any less so because deduced from experiments? It is a highly interesting state of mind which uses metaphysical expressions, and justifies them because they are alleged to have been come to by 'experiments' and not from philosophical considerations. A solid without density or weight! What is such a body? Is it nothing? I suggest that it is—nothing. But according to the thesis, it is the origin, and it is again the grave of the atom. The atom then came from—nothing, and it goes back to—nothing. But is not this the very proposition which, when it has been stated by philosophic or religious men, has been sneered at by the scientists? It is the very proposition! But then it was made for metaphysical speculation, and now that it has been stated from physical speculation (is that it?) or from experimentists, it is allowable! Nay we must yield

our consent to it. All I can say is, that never have I been asked to believe anything more transcending reason by any philosopher. The scientific men and the physicists and the experimentalists seem, certainly, to have got themselves into a quagmire regarding this solid without density or weight, and I wish them well out of it."

Thus the nature of ether cannot be said to be much more clearly defined than that of gravitation. Both remain unsolved mysteries, closely related to one another, and present many similar difficulties. Perhaps some "metaphysical Newton" will one day solve the problem!

HEREWARD CARRINGTON.

NEW YORK.

THE FRENCH NEWTON.

She was, in fact, a woman of genius.
Ernest Renan.

In the early days of our civilization, men, being finer, more intelligent, more keen-eyed and more joyful than to-day, became universally impassioned for Truth and Justice, those two lovely sisters upon whom we modern civilized people, herded into loathsome cities and indulging too often in tiresome, stupid toils, seem to look now with indifference and contempt. True sons of nature, amidst which they lived peacefully, they knew not yet of equatorials and telescopes, of experimental retorts, tubes and flakes, of balloons for experimenting in the upper regions of the air and drags and nets for researches into the lower regions of the sea, of registering thermometers and barometric charts, of scientific cinematographs and wireless Marconi. Indeed their five senses were so acute, so subtle that they almost amounted to a sixth one. Lovers of life and beauty with which their poetical souls were ceaselessly enraptured, and too respectful of natural life to irrationally imprison it in barbarous fashions, they enjoyed themselves in constantly developing their marvelous gifts, either in long journeys through mountains and valleys, forests and pastures, jungles and deserts, or in adventurous travels upon the liquid plains, or also during long pauses for rest on the verdant, fragrant islands, or by the well-sheltered shores of Hellas and its Asiatic colonies!

In such a splendidly luminous era—far too short, alas!—which rejuvenated humanity from the extreme east of Asia to the western

extremity of the Mediterranean world, about seven hundred years before the advent of Jesus, these giants of human thought sprang up. This wonderful constellation of geniuses whose thought, too deep and too synthetic for the narrow minds of the academies, remained misunderstood and practically unknown to the Athenians, who were then comparable in ignorance, frivolity and disregard of truth and justice to our "civilized people" of the present day! Later, Greece and its direct heirs, Rome and medieval Europe, paid indeed a costly price for this incomprehensive attitude of their fathers towards those who brought in themselves the salvation of the ancient world! Unable to oppose the smallest barrier to the invasion of the Oriental gods, antiquity in its last days became the prey for Paul's monotheism, that intolerant, dreadful curse which for nearly two thousand years usurped and retained the place in public opinion which should have been occupied by the luminous and valuable doctrines of the Ionian and Abderite philosophers!

Buried so many centuries under a colossal heap of falsehood and crime, the Ionian philosophy, like the phoenix, was suddenly restored to life on the banks of Lake Geneva, about half a century ago! Hesitating at first and doubtful of itself, it soon recovered its senses and rapidly assumed the full consciousness of its strength and value. Then appeared from time to time, in many periodicals of both continents, masterful studies on much discussed subjects. About twenty years after this miraculous resurrection, the grand, sublime natural philosophy, already reconstructed in all its parts, reappeared as suddenly as Minerva from the brain of Zeus, condensed and concluded beforehand in a small code of the Logos in which the logical law governing the whole of life was formulated once for all.[1] Finally, in the year 1900, a Parisian publisher edited the Bible of synthetic science, a wonderful, unique philosophical work, opening unlimited perspectives to all minds that long to penetrate the riddles of the cosmos!

Perhaps at this point I shall somewhat astonish my readers when I say that the philosophical brain that undertook and brought to an end such a titanic work was a feminine one! Yes, the "French Newton," the immortal writer of "The Constitution of the Cosmos" and of "The History of the Heavens" was one of those creatures condemned by the Catholic church as utterly vicious, malignant, haunted by devils, one of these creatures whom current ethics proclaimed irretrievably stupid! This really extraordinary woman,

[1] *Le bien et la loi morale.*

this vast genius whose bold, though generally just, inferences revolutionized science was Clémence Royer, the translator and intelligent critic of Darwin's *Origin of Species* who upset the old erroneous principles of theoretical science, declaring they had hitherto shown only the reverse of realities, and who, while playing with steel balls, discovered the molecular constitution of water in its three states and consequently the approximate constitution of the greatest number of chemical bodies.

But this is only one among the many inspirations of the great forgotten woman philosopher, inspirations which have thrown such dazzling light into dark branches of knowledge. The overturning of the hypothesis of attraction is another one and not the least important in its consequences. Adopting the beautiful conception of Demokritos who had guessed that the cosmos is filled entirely with elastic fluid units, Clémence Royer, with a remarkable power of induction, showed that all phenomena in nature are explainable and explainable only through this process of perpetual repulsion between the atoms. In fact, such a system is far in advance of the Bergsonian concept of a "dynamical continuity." Here in Clémence Royer's theory we have at last an integral definitive philosophy of nature, whereas the Bergsonian thought is only a very misty, esoteric, superficial one, only a very timid insight of a logical truth already duly discovered!

Other very remarkable inductions of the "French Newton" have been corrective of and complementary to the Darwinian theory. Let us only quote here the two principal ones. One is the hypothesis of the plurality of organic sources rediscovered recently by the Mary Brothers and called by them *polyphyletism*. The other is the theory of long polar rotations whose admission now explains most of the enigmas of geology and paleontology. We may say here that the history of the earth from such a standpoint is an extremely interesting science, much more beautiful, much more pleasant than Jules Verne's and H. G. Wells's novels. To-day we can clearly realize how the ancestor of man, naked and without natural weapons, forever left his oceanic abode in the same period as all the ancestors of reptiles, birds and mammals; how he fought for the conquest and exclusive possession of the land against the other living species; how finally he took their place and destroyed them without restraint and discrimination; how in our own days, upon this planet conquered by him, he goes on to seek for his rule and law which he will not find until he has attained a thorough insight of his environ-

ment, of his true nature, of his true situation in the cosmos, until he will have realized how to harmonize his own life with the life of the cosmos!

Such, in a few words, is the original conception of the cosmic substance rediscovered, reconstructed in all its parts and considerably extended by the cyclopedic brain of a woman. Such is the immense, the grand synthetic philosophy, both cosmic and human, far the finest, the most complete, the most exact of all, in fact the only one which is exact, the only one which supports discussion, the only one worthy to be studied and nevertheless the most unjustly misunderstood, the most blindly criticized, the most stubbornly and systematically boycotted by all sects, whatever they may be! At the very moment when I am writing these lines, eleven years have elapsed since the death of the "French Newton," and with the exception of a few cuttings reprinted here and there by sympathizers, not a single one of her immortal works has been reprinted yet, not a single one of her unpublished manuscripts has been published by the committee she entrusted with the duty of seeing to their publication. It is true that this committee is yet unaware of its own existence, as I ascertained by a recent letter from one of its members. At the present day, atomistic dynamism is not taught in a single school in Paris! No French scientific group, except one composed of two dozens of adherents, takes any interest in the diffusion of the rational doctrine! Yet, two years ago at the Stanislas College in Paris, under the direction of Jesuits, M. Saulze made a most stupid criticism of the theory of "Mademoiselle Royer." More than that, in October, 1912, six hundred copies of my little book, *L'atome fluide,* suddenly disappeared from their place of storage, stolen or perhaps destroyed by a hand supposed unseen! It is clear that a new cosmic theory which hunts Jehovah out of the universe prevents its supporters from enjoying peaceful sleep!

But truth is an invincible force! Having awakened from her long lethargy, she has resumed her course at last, and if her first steps were rather clumsy and uncertain, she is now treading an onward path and nothing can stop her advance throughout the world. Without being a prophet, I can foretell that my booklet, of which but a few hundred copies have been bought, will be translated tomorrow into many languages, that by the mere force of truth it will indeed become a great success, and that each copy of it which has been stolen will bring me at least a thousand readers! In

September, 1912, a few weeks before this imbecile deed was committed, the International Freethought inaugurated a memorial inscription at the farm of Praz-Perey on the banks of Lake Geneva, at the house in which Clémence Royer's thought freed itself from darkness and prejudices and opened to the light of scientific truth. The ceremony at Praz-Perey was exceedingly simple, indeed such as Clémence Royer herself would have wished it. Unfortunately, when I read the speeches delivered on that day, I had the impression that the speakers did not exactly realize the true extent, value and import of the work that the immortal woman leaves behind her. As to ourselves, having spent six whole years in diffusing and completing the doctrine, we can advance it as the remedy which our humanity is waiting and hoping for in order to be cured once for all of the religious mania and of that discomforting skepticism which results from the loss of one's dearest creeds and beliefs!

ARISTIDES PRATELLE.

PARIS, FRANCE.

DR. EDMUND MONTGOMERY: AN AFTERMATH.

The late philosopher Dr. Edmund Montgomery, who died on April 17, 1911, an obituary sketch appearing in *The Open Court* for July, 1911, left as the crystallization of his intellectual life two important volumes: *Philosophical Problems in the Light of Vital Organization* and *The Revelation of Present Experience*. The former received extended notice in *The Monist*, Vol. XIX, No. 4. The latter was reviewed editorially in the issue of July 1911. In comment on our review of this book Charles Alva Lane writes to *The Monist* expressing disagreement with the reviewer's assertion that Dr. Montgomery "bases his monism upon a mental substance as ultimate reality," and Mr. Lane's strictures are similarly urged by William M. Salter.

Mr. Lane expresses his criticism in a letter as follows:

"It seems incredible that you would charge Montgomery with theistic tendencies, even though he 'favors a teleological interpretation of nature'—the Charybdis into which he runs in his efforts to escape the Scylla of the mechanistic creeds.

"In his attempts to define the ultimate reality Montgomery has, indeed, been compelled to bring to bear all his lingual dexterity, for it requires pretty deft juggling of thought to avoid identifying

the *substance* of his 'matrix' with the 'soul-stuff' of the theosophists or the 'spiritual body' of St. Paul.

"So far as I can remember, Montgomery's closest approach to a definition of that which he characterizes as veritable and only substance is as follows: 'This steadfast producing matrix cannot possibly be of the same nature as the changeful, evanescent phenomena that transiently arise in the conscious content.' Later he writes: 'These hypothetical existents, inert matter and moving motion, cannot rationally be conceived as endowed with memory.' Thus his 'substance' is, apparently, of neither mental nor physical consistency. He classifies it as 'extra-mental' though he adds this may seem paradoxical. It is a specific element of existence brought into kinetic conditions through vital organization only. Its 'steadfastness' has probably a physical basis, and its synthetizing power amid the elements of the conscious content is analogous to the crystallizing properties of the chemical compounds. That affinities respond in the thought-world is really less marvelous than the operations of mere chemical affinity. The real marvel lay in the fact of the interaction of these disparate sets of affinities. Since organic structure results solely from vital functioning, the material of structure must be, in some wise, affinitively related to the specific energies of vitality; and mental states, whether causative of functioning or mere concomitant epiphenomena, must, in turn, reach over in some manner and get into rapport with the somatic basis of structure.

"Montgomery's 'matrix' seems to be a sort of central work-shop of all these multipotent activities. But is it, after all, of mental consistency, even though its products be mainly mental?

"To Montgomery there is, above all things, an extraconscious entity that must be reckoned with, and the character of which, save in inadequate simulacra and representative symbols, is incommensurably beyond the powers of our ken. In the human body its most marvelous development has been attained. Organic life chemically originated from it, drawing with it the potencies involved in the elaboration of sentiency, consciousness and the activities of mentality.

"Nowhere, so far as I can recall, does Montgomery use the expression 'mental substance.' Always his 'substance' is a substrate of the fleeting pageantry of mental states. It is that 'extra-conscious matrix which latently preserves past experiences,' and without which 'no conscious content whatever will arise into awareness.' This has

its seat somewhere in the recesses of the perceptible body, and by dint of its regenerative qualities 'maintains its identity and efficiency unimpaired, while producing or emitting a sustained manifestation of natural phenomena, being in fact the proximate source of this becoming of conscious appearances.' Mentality, then, is a most specific outcome of a process which is basically chemic, and liberated, Montgomery might say, from the essential potencies of the substratum of life—that extra-conscious world which keeps in most permanent and intimate rapport with life through that steadfast condition of the ectodermic structures which yields the sense of identity amid change.

"The 'creative trend' of organic substances, and indeed of all nature as manifested in the evolutionary processes, is a feature of existence which Montgomery distinctly ascribes to intrinsic efficiencies, no supernatural mental substance, or *ab extra* teleological impulse being concerned in the process."

So far Mr. Lane.

In the light of Mr. Lane's objections, we have reconsidered our description of Dr. Montgomery's monism as being based upon a "mental substance" and will say that all depends on the meaning we, and in this case also Dr. Montgomery, may attribute to the term "mental substance." In personal conversation, if we remember rightly, Dr. Montgomery did ascribe a nondescript mentality (not a fully developed mind with brain action and discursive thought but the cause of it) to the substance of his matrix; we will not however insist that he used the term "mental." Certainly he would not have identified (to use Dr. Lane's words) "the substance of his matrix with the 'soul stuff' of the theosophists or the 'spiritual body' of St. Paul." Nor did we ever understand Dr. Montgomery's philosophy in that light. However, similar terms have been used by other authorities, as for instance Clifford whose conception of "mind-stuff" is well known. We do not believe that Dr. Montgomery would have objected to a comparison of his own with Clifford's view. Dr. Montgomery's notion of substance which he called "extra-mental," was certainly not purely material, and it was to him the source of all mentality.

We have good reasons to assume that Mr. Lane is thoroughly familiar with the latest works of his friend, and so we will grant that therein the term "mental substance" is not used, but we shall see later on that Dr. Montgomery did use it in former writings

of his, although he uses it in a somewhat different sense. We do not insist on the term, but we believe that Montgomery's conception of a matrix implied the idea of a substratum which might be characterized as mental substance, for he ascribed to it the potency of mind. Our interest in Dr. Montgomery has been more of a personal nature and we feel that the public will be interested in becoming better acquainted with his character and the closing events of his life.

The problem of philosophy uppermost in Dr. Montgomery's mind was the nature and origin of the individual, a problem of which we have offered our own solution in a little book entitled *Personality*. Dr. Montgomery's solution was different. He saw the shortcomings of Virchow's cell theory and claimed that an aggregate of many cells would remain so many cell-consciousnesses but can not constitute a human personality. The cells know nothing of us and we know nothing of the cells—ergo there must be a central monad. Here Dr. Montgomery's views remind us of Goethe's soul monad which the great German poet assumes to constitute man's entelechy.[1]

We will let Dr. Montgomery explain himself in extracts which we quote from his essays published in the prime of his life. He says:[2]

"To us it matters really not one jot whether our nerve-cells, if such we have, do possess inward experience, or not. Our consciousness is clearly not their consciousness. Our *I* cannot be possibly composed of any *we* of theirs. In irrelational solitude, each of them has to enjoy for ever its inner life utterly incommunicable, utterly exclusive. There can be, as we have plainly seen, no vital synthesis of their sundry intrinsic activities. No vital cell-medium is at all conceivable, in which their respective inward experiences could be combined as joint-effect. Their individual functional commotions, if at all accompanied by feeling, have to ring out separately without power of ever sensorially or inwardly influencing each other's lives in the least degree. The billions of cells of which the organic being, as a 'cell-aggregate,' is thought to be composed, are just so many elementary organisms, with just so many elementary functions, with just so many elementary unrelated sensorial experiences, if at all endowed with feeling.

"Our inner life, on the contrary, consists of a unitary synthesis of most complex and diverse relations to other beings. It can therefore have nothing whatever to do with the many and primitive lives

[1] See the editorial article on "Goethe's Soul Conception" in *The Open Court*, XXI, p. 745.

[2] Quoted from an essay published in 1880 under the title "Are we Cell-Aggregates?"

of nerve-cells. If, as we are all positively convinced, the nervous system is nevertheless subservient to our sensorial and other mental experience, it certainly cannot be so by dint of the inner lives or sensorial experiences of its 'cells.' The only conclusion to which the cell-theory here necessarily leads is, that the specific vital commotion of nerve-cells must be construed as stimulating a unitary, hypervital substance to those activities which we call our mental life. Indeed there have to be hypostatized in vacancy the virtues of exactly such a substance, as I, in my counter-theory, have conceived the nervous system itself actually to be. The initial points of sensorial stimulation, instead of being situated at the sensory inlets, would have to be shifted to where the central 'cells' have to impart their sundry specific commotions as stimuli to a mental substance.[8] Under this arrangement nerves would be 'field-telegraphs' indeed, but the 'headquarters' and the central telegraph operators would be found nowhere within the confines of this world.

"It is only want of insight that has hitherto prevented spiritualistic reasoners from utilizing, as a solid basis of operation, these inevitable conclusions of our present biological science. I would earnestly recommend to them the serious study of biology. The science that has of late so discomposed the even tenor of their thought, is now once more at their mercy. It is open to the humiliating taunt that, setting out with the avowed aim to explain life physically and chemically, it breaks down before ever reaching physics and chemistry. With the full mystery of vitality still on its hands within its units, the 'cells,' it fails even then to put complex life together out of the vital material it assumes. It is in the power of those who believe in a hypervital substance of mind, to force upon biologists the consciousness of their shortcomings.....

"If cell-theorists persist in flattering themselves with the adequacy of their doctrine, still continuing to ignore its flagrant inconsistencies and shortcomings, even after they have been again clearly pointed out to them, it cannot alter the fact, that they are lagging far behind in their understanding of life. Perhaps, however, they may think it now worth their while to attend to the difficulties here exposed. If so, I may entertain some hope, that they will come to learn from nature the lessons forced upon me by an unprejudiced yielding to her teachings. Then we shall be delivered from the ludicrous position of having, *secundum artem*, to consider ourselves a congregation of ever so many primitive lives, and shall feel scien-

[8] Here Dr. Montgomery uses the term "mental substance."

tifically restored to the full dignity of indivisible, autonomous personalities."

Mr. C. A. Lane writes to the editor concerning the use of the term "mental substance" in this passage, as follows:

"Montgomery is here demonstrating the inadequacies of the cellular hypothesis, contending that to logically complete the chain of phenomena which forms the biological problem, there must be 'hypostatized in vacancy' a mental substance 'to be found nowhere within the confines of this world,' but ready-made and supernaturally equipped with endowments for receiving and transmuting into mental forms the sundry specific commotions initiated by sensorial stimulation.

"To Montgomery there was no such mental substance existing in vacancy, for he distinctly asserts "the virtues of exactly such a substance" abide in the functions of the nervous system of the indiscerptible unitary being,—a system phyletically developed by a specific chemical process most intimately interrelated with the influences of the environment. The inscrutable chemical activities and concomitant mental manifestations of this sensori-motor nerve-system are perpetuated by reason of a self-reintegrating attribute which maintains, through mnemonic properties, the sense of identity amid change, so constituting a veritable substance. But mentality is only one of its manifestations, albeit the most remarkable."

In another article entitled "The Unity of the Organic Individual," Dr. Montgomery offers his solution of the problem of the soul which in his opinion the cell theory fails to give, and we quote from it the most important argument as follows:

"It is only fair to confess that chemical activity, with its definite selective preferences and its constructive origination of specific properties, is an ubiquitous energy at present completely beyond the reach of our scientific comprehension. Neither physical nor psychical interpretations have hitherto availed to throw any light on its mysterious nature. The various attempts at a mechanical explanation, i. e., at a reduction of chemical laws to the simple laws of mass-motion, have not even succeeded in offering a plausible suggestion as a hypothetical basis to start from. And with regard to our modern hylozoism, inspired by Schopenhauer and becoming prevalent even among the scientific celebrities of our time, it can only be said that it plainly proves that we have once more exhausted the combinations all round. We are growing conscious that our earnest and most determined efforts to make motion produce sensation and

volition have proved a failure, and now we want to rest a little in the opposite, much less laborious conjecture, and allow any kind of motion to start into existence, or at least to receive its specific direction from psychical resources; sensation and volition being for the purpose quietly insinuated into the constitution of the ultimate moving particles. If, however, evolution is to be our scientific creed, we can expect the great and good things only after strength has been gradually gathered through endless toil.

"Chemical elaboration then discloses itself as the secret activity of which the vital energies are concomitant manifestations. Of whatever ultimate incident chemical composition may be the perceptible symbol, to us it is the embodiment of a synthesis accompanied by the appearance of new properties, scientifically incalculable and unaccountable.

"The properties of the molecule of water are even less intelligible to us than the properties of the living molecule. Of the former we possess only a mediate knowledge; of the latter, also some little immediate knowledge.

"From point to point we are formulating the great truth that the centralized animal organism represents only one single monadic molecule."

* * *

For several years Dr. Montgomery had led an isolated life. His own cheery words will give some idea of his outlook on life after his last fatal stroke of paralysis. On June 18, 1908, he wrote to a friend as follows:

"I am now a prisoner for good, without hope of ever becoming able to leave my home again. I am, however, quite reconciled to my fate. My general health is good, my spirits never dejected. I live alone in the large colonial house, attended only by our faithful housekeeper, now 74 years old, who has been with us more than 40 years. She is getting very feeble, but insists upon letting no one wait upon me but herself. So to save her as much work as possible, I have reduced my wants to a minimum, and live in almost complete solitude, quite satisfied, for I am inured to solitude, and time never seems too long for me.....

"I never feel the want of any mere social entertainment, but there is no higher enjoyment for me than the exchange of thoughts with congenial companions. And one's inspiring ideas being understood and appreciated as they are by your poetic penetration, is rarest benison.....

"Personally I am indifferent to success, though I have never doubted the final outcome. The biological discoveries and the recognition of their significance have for years kept me in a glorious state of exultation that needed no outside fuel to keep it aglow. I find it quite natural, remembering how theological opinions of the crudest type are relinquished with the greatest difficulty, that it should fare in a similar manner with scientific and philosophical views. The facts of nature are perennial, but their interpretation changes with the nature of the interpreter and the state of knowledge attained."

Dr. Montgomery's acquaintanceship embraced a wide range of the world's most noted men during the past three-quarters of a century. His friends will be sorry to learn that the eve of his life was obscured by utter loneliness, making his demise almost tragic. The most intimate American friends of Dr. Montgomery were Judge Reese, of Austin, Texas; Rev. William M. Salter, of Cambridge, Massachusetts; Charles Alva Lane, of Alliance, Ohio, and finally the new owners of Liendo Plantation, Mr. and Mrs. Harris who, luckily for the lonely patient, were kindly disposed to him and very sympathetic. Judge Lipscomb, of the Warren County Court of Texas, writes as follows:

"It is a pity that a man like him should have spent his last days among strangers not bound to him by any ties. Otherwise it was very fortunate that he fell into the hands of such worthy people who did everything they could to make him comfortable and contented. Dr. Montgomery was one of the most polished and lovable characters that ever lived in this part of our state, and his memory will long be revered by those who knew him."

Concerning his last days we will quote a personal letter from Mrs. Harris, whose kindly services were tendered the lonely philosopher during his latter days, and who was present at his death.

"Liendo Plantation, Hempstead, Texas.
"September, 20, 1911.

"Mr. C. A. Lane,

"Dear Sir:

"Your letter to Mr. L. N. Montgomery has come to hand. In the absence of all the Montgomerys I am to open the mail.

"Let me first introduce myself. I am the wife of the new owner of the old Plantation and was with Dr. Montgomery in the big house many days before his death, the 17th of April last. We all loved

him. He had been very much alone since he was stricken with the paralysis which shortened his life, having with him only the faithful old housekeeper, Cenai, who came with them from Germany nearly fifty years ago.

"In looking over his correspondence I see many letters from you to the Doctor. After receiving such great honors in his youth and middle age, for such a brilliant intellect to be drifted out almost alone was a tragedy.

"I think you were in close enough touch with him to have learned much of his home affairs. I came to him a stranger, but he seemed to like and trust me from the first. His wife not taking his name made it very unpleasant in many ways. Miss Ney, you know, was a great sculptress and, with the eccentricities of an artist, entertained many queer notions. She would be simply 'Miss Ney,' never permitting herself to be called Mrs. Montgomery after the conventional manner.

"We came from the North and fell in love with the place, so bought it at once. He had sold it to a party three years before but retained a life lease on the home. This he gladly signed over to us. He still had his one thousand dollars a year from the estate of his father who was Lord Chief Advocate of Scotland. Through meddling outsiders Dr. Montgomery's one son had for some time been estranged from the father, but after Miss Ney's death a will was made by the Doctor leaving all to his son.

"Had he been near any of you, his closer friends, he would have been better off. There was no one here for whom he cared deeply, or who could sympathetically enter into his troubles. Being an outsider, I could readily see what havoc had been wrought upon his sensitive nature and brilliant mind. The son came and looked over the papers and letters. He knows nothing at all of his relatives. For twenty years he has been a sort of Ishmael in his parental home, though no blame, I think, need attach to either the Doctor or the son for these conditions. I will send your letter to the son. He will be more than glad to get any information you can give him. All the printed matter is here. The plates from which were printed *Philosophical Problems* remain the property of Dr. Montgomery by contract. Can you not secure and preserve these? The son will do anything you wish about them.

"All told, the Doctor left about $4000.00 in cash, but no property, and $3000.00 of this is in trust for the old housekeeper. At her death the fund goes to the son. The books were left to Judge

Reese. He took some and left the rest to the son. Some of Miss Ney's marbles should bring something, but now some one comes in with a Bill of Sale and claims them. But the Doctor never signed it. He told me so before his last fatal spell, and he was incapable of telling an untruth.

"The son has several children. He is of generous nature, quick-tempered, but unusually bright. German, French, Spanish, and Italian are as easy to him as the mother tongue.

"The Doctor desired no formalities at his funeral. He wanted but a few to attend, and he was buried in the yard at Liendo. At his request I placed the ashes of his first-born—a boy who died at the age of eighteen months—in the coffin with him.

"My heart ached to see him so alone. I filled his coffin with honeysuckles and the wild flowers he loved best. He looked like a piece of marble in his coffin. His grave and that of his wife are both in view from my window as I write, and often I carry flowers to strew upon the sacred spot. You see he had never told us to whom we should write, or I surely would have sent you word a month before his death. But if you had seen him you would have been only grieved, for he could not speak, and in his eyes there was such pitiful desire for utterance.

"He had not written much since his last book was issued. One day he said to me 'How we wear out our bodies and ruin our brains with all this foolishness! And now,' he said, 'I am done, virtually dead, and I have accomplished nothing to help the world or myself.' I think he referred to his scientific work which had not wholly satisfied him. 'Centuries hence,' he continued, 'men will, like myself, struggle with the same problems, never coming nearer to a solution.' Don't you think a vein of this sort runs through his last book? I have marked many passages which I think refer more to every-day life than any that are to be found in his former writings.

"I hope the son will find some of the manuscripts you would like. In the meanwhile you can write me if any copies of the Doctor's magazine articles would be of benefit to you. In a short time I will send you a photograph of him. I told the son to have some taken, as several European friends of the Doctor had asked for copies.

"Hoping to hear from you again, I am

"Very respectfully yours,

L. B. Harris."

A portrait of Dr. Montgomery reproduced from a photograph was published in *The Open Court* of March, 1912. The same number contains pictures also of his wife Elisabet Ney, her studio and some of her sculpture. P. C.

CURRENT PERIODICALS

The number of *Mind* for January, 1913, contains an article on "Rationalism and Empiricism" by George Trumbull Ladd. There is probably, he says, no other subject of controversy about which, and no other word under the cover of which, there has been more deplorable confusion and consequent inner bitterness and outward contempt than the subjects covered by the word "rationalism." "Strictly speaking, the words rationalism and rationalistic are properly used in philosophical terminology only as applicable to a certain *method* of exploring and ascertaining truth. Whenever they are used as applicable to the *content* of truth supposed to be thus ascertained, they are either misused or should be understood with caution. In violation of this caution, for example, pragmatism borrows the words, with all the opprobrium attaching to them in certain quarters, from the theological controversies of one and two generations ago, and in the name of empiricism holds up to ridicule and scorn many of the tenets of philosophy which were thought to be established on an empirical basis against the reigning dogmatism of that distant time. But rationalism is no more antithetic to empiricism than it is to idealism, or to realism, or to supernaturalism, or even to pragmatism. One might seem more justified in opposing it to scepticism; although it has almost invariably been identified with the most dangerous forms of scepticism when it has attempted to apply its method in a too unrestricted way to the problems of morals and religion. But on the one hand, one can neither theologize nor philosophize without some scepticism; and on the other hand, too much scepticism undermines all the authority and destroys all the work of reason, whether it be within the field of philosophy or theology, or even of the positive sciences."

S. Alexander, in a paper on "Collective Willing and Truth," continues the working out of a scheme of his for expounding psychological processes which depends on the principle that on the different levels of experience, perception, imagination, memory, and so on, there corresponds to each form of conation a certain form of non-mental object, or *cognitum*. The paper is to be continued,

and there are here published nine sections, which are concerned with experience of other minds, truth and intersubjective intercourse, goodness and truth, collective and individual believing, the science of truth, and mental propositions and their truth.

M. M. Pattison Muir deals with "Alchemy and the Absolute." "The Alchemists," he says, "were the most patient and thoroughgoing pursuers of absolute truth who have appeared among those who profess themselves scientific investigators. It cannot but be interesting to compare the aim, the method, and the phraseology of the alchemists, with the aim, the method, and certain technical expressions of the absolutist philosophers."

George H. Langley considers, in a paper on "The Metaphysical Method of Herbart," the method put forward by Herbart as the instrument by which inference can be made from the common concepts of experience to such knowledge of reality as shall render a rational explanation of experience possible. Herbart's philosophy is founded on Kant, as is Hegel's, though Herbart and Hegel are almost wholly opposed to one another. Hegel is the better known, for Herbart's attempt at continuation has been much ignored, and there is no English work on the subject; yet it is of interest as leading to a consistent pluralism.

In the "Discussions," there are three articles: one by B. Russell on some criticisms of G. Dawes Hicks on his views on sense-data in his *Problems of Philosophy*—this article contains a welcome and much more precise statement of his views—; H. P. Cooke has some remarks on his reviewer in "Ethics and the New Intuitionists"; and F. C. S. Schiller has a note on "Mysticism *v.* Intellectualism." Among the "Critical Notices," a notice by C. D. Broad of Meinong's book *Ueber Annahmen* is particularly to be noticed.

* * *

The number of the *Revue de Métaphysique et de Morale* for January, 1913, begins with an article by A. Meillet on the method of comparative grammar, where he describes the principle of the process of reasoning of the cultivators of comparative grammar and examines the demonstrative value of this reasoning. L. Weber, in an article on the rhythm of progress and the law of the two states, continues the working out of his hypothesis that intellectual progress, instead of obeying Comte's law of the three states, shows the kind of binary rhythm consisting in the alternation of preponderating influence of technical activity and speculative activity. Charles Dunan continues his study on the nature of space; the present article

is devoted to the nativistic conception of space. S. Ginzberg has a note on the equivocal meaning of particular propositions. "The quantification of the predicate, which is necessary when judgments are to be translated into equations, is quite useless for any one who only aspires to a satisfactory precision of the particular judgment. Thus I will accept as an interpretation of this judgment: 'Some and nothing but some S's are P's,' without asking whether S is subordinated to P or merely *crosses* with it. To express itself the particular judgment may say $v\mathrm{S} = v\mathrm{P}$ and $v\mathrm{S} = \mathrm{P}$, but not $z\mathrm{S} = v\mathrm{P}$. Thus, what I have done is the quantification of the subject." P. Boutroux has a critical study on L. Brunschvicg's *Les étapes de la philosophie mathématique*; and finally T. Ruyssen has a discussion on the practical question of temperance.

* * *

"*Scientia*" (*Rivista di Scienza*) begins its thirteenth volume with the number for January, 1913. It is described as an "International Review of Scientific Synthesis"; appears every two months; and contains French translations of the Italian, German, and English articles, as well as the originals. E Walter Maunder has an article on sun-spots, giving astronomical details on the cycles of sun-spot activity.

Marcel Brillouin has an interesting article on the principle of relativity. This theory has been described in *Scientia* in enthusiastic articles by Castelnuovo and Langevin; but the present article is by a sceptical physicist and sounds a critical note. The new theory ignores the ether, and we cannot do this because electro-magnetic disturbances, unlike gravitation, require a finite time of propagation: "The existence of the ether is as certain for us as that of the air could have been before the invention of the pneumatic machine and compression-pumps." It is refreshing to read that "everybody agrees" about the relative motion of two material systems. Here the question is about the relative motion of a material system and the ether, and it must be remembered that the velocities which we can produce artificially on systems of some size are very small as compared with that of light. The work on whether there is a relative motion of material systems and the ether or not, of Stokes, Lorentz, Michelson, Fitzgerald, and others is referred to. The association of rigidity with perfect permeability to the motions of matter was an enigma—no greater nor less than the permeability of an immovable ether to electrons in the theory of Lorentz. To avoid this, the relativists propose to adopt for the electro-magnetic field the abstract

and purely algebraic point of view which we adopt, in default of better, in gravitation, where we cannot find any velocity of propagation; then, having taken away every material support for radiant energy, they have been led to attribute to this energy the two principal characteristics of materiality, inertia and weight. To put at the beginning of the theory the new principle of relativity which is based on a few electro-optical observations, and to extend it to the whole domain of natural science, is not physical but metaphysical.

M. Smoluchowski has an interesting article on the number and sizes of molecules and atoms. He protests against the tracing of a scientific atomic theory to Leucippus, Democritus, and Lucretius. Modern physics is an exact science, and atomism as an exact physical and chemical theory does not go back beyond Daniel Bernoulli (1738). The work of Dalton (1808), Hauy (1784), Bravais (1849), Clausius, and Maxwell; investigations on the size of atoms as due to Loschmidt (1865), Lord Kelvin, Dorn, Exner, Van der Waals, O. E. Meyer; and then very modern researches are referred to. Hardly has physics attained the solution of a fundamental problem of atomism when a number of other riddles arise. It is well that this should be so: if not, physics were a dead science.

E. Rignano studies the psychological nature of reasoning. In his previous articles in *Scientia* on attention etc., he traced the phenomena from their manifestations in the case of the lower animals, but in this article he follows a different method and only analyzes certain of the simplest and commonest forms of reasoning with human beings; in a second article the evolution of reasoning will be considered, and in a third article a study of its higher forms will be made.

F. Kühnert has an article on ideographic writing with the Chinese, which is of the greatest possible interest in connection with the analogy that Chinese offers with the symbolic logic of modern times. The formation of the Chinese characters, in its four stages, is described, and a wish is expressed that, when European civilization spreads to China, the language and the writing will remain intact.

R. Dussaud writes on the part played by the Phenicians and the Mediterranean Sea in primitive times. This part was a great one both from the points of view of politics, commerce, and general culture. The present article does not trace the various stages of it so much as show the method by which its history must be made precise. It is very curious, in fact, that Phenician history has been

attempted to be founded by means different from those used in Greek and Roman history.

Finally, G. Marchesini criticizes Lemaître and maintains the modernity of the educational views expressed by Rousseau in his *Emile*.

* * *

The number for March contains a critical discussion by M. P. Rudski on the various methods for determining the age of the earth. These methods are: (1) that which depends on the theory of geological denudation and accumulation of deposits (Geikie); (2) that which depends on the theory of the secular cooling of the earth (Lord Kelvin and others); (3) that which depends on the salinity of the sea (the idea was due to Halley and the method has been developed in modern times by Joly and von Romer); (4) that which depends on the theory of the disintegration of radioactive matter (Strutt, Holmes, and Boltwood); (5) that due to G. H. Darwin in his researches on the evolution of the moon. The author concludes that, from whatever side we attack the problem we always arrive at the conclusion that the earth has a history dating back hundreds of millions of years.

E. Pringsheim contributes a somewhat technical article on radiation of heat and luminescence, which deals with the conditions under which Kirchhoff's law of radiation holds.

G. Henslow writes on ecology considered as bearing upon the evolution of plants. The word "ecology" was invented by Haeckel and means the study of plants and animals "at home." It is no longer enough for botanists merely to collect plants and examine the structure of their flowers and so on, solely with the view of their classification, as was formerly done; and it is ecology which everywhere reveals the origin of species by direct or self-adaptation to new conditions of life. This conclusion derived from the study of plant life is equally true for the whole of the animal kingdom.

F. Oppenheimer has a long article on value and excess value. The first part of this contribution to political economy is on the "monopoly" theory of excess value.

E. Naville writes on the scholastic method in the science of language. The word "scholastic" is not used in a depreciatory sense; it is defined as a method of argument founded on reasoning and not on facts of observation. In modern times people have begun to study living and spoken languages which are rapidly becoming obsolete; and the author believes that this science of linguis-

tics, which takes care not to construct, by the help of pure reasoning, theories which are logically very sound but are only artificial creations, is in the right direction.

R. Pettazzoni deals with the science of religions and its method. In the usual division of the study of the history of religions, non-civilized peoples are put on the same plane as civilized peoples of antiquity and of modern times; neither the historical method (a study in time) nor the comparative method (a study in space) ought to be exclusively used. There is, says the author, one thing which is certain. It is that we have not here to deal with two methods which we have to make to walk side by side, but with a unitary conception which is founded on the nature of the object—the religious fact which is one and definite in its essence—which is proper to it.

A critical note by A. Levi deals with the problem of morals as exposed in a book by Limentani. There are two general reviews; one by F. Botazzi on some fundamental concepts of the chemistry of colloids; and the other is by A. Van Gennep on the Iliad as an economical poem, with reference to Walter Leaf's *Troy, a Study in Homeric Geography* (London, 1912).

* * *

The first number of *Isis,* an international quarterly journal devoted to the history of science, appeared in March. The aim of this journal is to study the genesis and development of scientific theories, taking account of all the changes of ideas and influences that the progress of civilization constantly brings into play; and to unite all the materials necessary for this study and perfect its method and working-instruments. The ideal program of the journal is admirably sketched by the editor, Dr. George Sarton, in the first article of the number. After insisting on the necessity of closer relations between science and philosophy, he deals with the special subject of the journal: the history of science. The history of science as a whole, and thus as distinguished from the history of the sciences, was founded by Comte and continued, almost alone, by Paul Tannery. The definition of the history of science is that given above, and the author proceeds to examine, from the point of view of the interest they possess for this study: (1) the history of civilization; (2) the history of technology; (3) the history of religions; (4) the history of the fine arts; (5) archeological, anthropological, and ethnological researches. From the scientific point of view history has a great *heuristic* value, as has been emphasized, perhaps in rather

an exaggerated way, by Wilhelm Ostwald. The original work of the old masters of science is still full of treasures; and we must remember that not only is history important because there is often a recurrence of ideas in science—for example, some modern cosmogonies have forsaken Newton for Descartes—but also historical studies offer ground on which the splendid critical work of Mach, for example, has been raised. The author quotes the words of Mach:[1] "Those that know the entire course of the development of science, will, as a matter of course, judge more freely and more correctly of the significance of any present scientific movement than those who, limited in their views to the age in which their own lives have been spent, contemplate merely the momentary trend that the course of intellectual events takes at the present moment." Dr. Sarton then discusses the educational point of view and the point of view of individual and collective psychology, and concludes that *Isis* will strive: (1) to make the elaboration of a manual of the history of science possible; (2) to encourage the production of scientific text-books in which the matters are treated in the historical order of their development; (3) to prepare the sociological synthesis of humanity; (4) to reform, on deeper and firmer bases, the work of Comte.

The other articles are a note by I. Guareschi on the history of the movement discovered by Sir Robert Brown in 1827 of the particles contained in the pollen of plants; a note on the origins of science by G. Milhaud; and a biography of Paracelsus by E. Radl. There is an obituary notice of Poincaré, a portrait of whom is a frontispiece to this number; and there are notes on projected books and congresses, and analyses of published books. Finally a very important bibliography of the publications relating to the history of science which have appeared since the beginning of 1912 is started here. Where possible, publications are arranged in order of time, so that a first step is made towards the exhibition of the influences of the contemporary sciences on one another. It will be seen that the ideal of this new magazine has many points of contact with the ideal of *The Monist,* and we wish the new journal every success and shall make a point of collaboration with it for what ends are in common. Φ

[1] *Mechanics,* 3d. ed., Chicago, 1907, p. 7.

BOOK REVIEWS AND NOTES.

LIFE IN THE MAKING. By *Loren B. MacDonald.* Boston: Sherman, French & Company, 1911. Pp. 223. Price $1.20 net.

The author, who is a disciple of William James, endeavors to establish religion on the basis of pragmatism. He calls his effort in a subtitle "An Approach to Religion Through the Methods of Modern Pragmatism." In the foreword Mr. MacDonald says:

"That religion bears some message of supreme value to human life is an assumption, more or less explicit, in all the great historic faiths. It has been taken for granted that in some way or other man's life on earth is safer, worthier, happier with religion than without it. All the more unfortunate it seems, therefore, that this desirable treasure should have been offered to man at the price of an intellectual sacrifice which he is sometimes not willing to make. Must the only entrance to a temple so beautiful and inspiring always be that of some difficult creed or doctrine? Shall man forever be expected to perform some strenuous, and to many, impossible, mental feats in the form of belief and assent before he can enter in and enjoy its harmonies? He is not called upon to yield that intellectual tribute at the shrine of other great emotional or spiritual interests. Art and music, for instance, do not demand any humiliation on the part of reason and intelligence before they come with their blessed ministry to human needs. Why should not the religious interest, supposed to be of far more significance to life than these, offer its ministry on terms equally acceptable?"

His relation to pragmatic philosophers he expresses thus:

"In a humble, but earnest attempt to depict such a pragmatic form of religion in the following pages the author does not wish to involve any one else in whatever misrepresentations or logical defects of which the attempt may be guilty. While acknowledging his indebtedness to the chief expounders of philosophical pragmatism, and especially to Prof. William James, at whose feet, both in college and out of it, it has been his good fortune to sit as a humble learner, he does not claim their authority for more than the bare suggestions of the opinions here expressed."

The chapters of the book are naturally more sermons than expositions. They are written in a tone of prophetic ecstasy and are entitled respectively Life Simplified, Life Rationalized, Life Revealed, Life Under Orders, Life Shared, Life Spiritualized, Life Made Whole, Life Strengthened, Life Creative, Life in Reserve, Life Re-Enforced, Life Triumphant.

In the conclusion he pictures "the ideal of a church that may sometime be founded on the pragmatic principle in religion." K

Geschichte der modernen Naturphilosophie. Von Dr. *Carl Siegel.* Leipzig: Akademische Verlagsbuchhandlung. 1913. Pp. xv, 390.

It was originally the author's intention to give a picture of the modern natural philosophy movement, the movement represented by Mach and Ostwald, Helm, Kreibig and Verworn. He has for many years collected material for such a study, in which a sketch of the German natural philosophy of the last four centuries should occupy the position of an introduction. His decision to enlarge this introduction into an independent treatise and to publish it separately must be welcomed as the only work that treats historically of this movement that of Julius Schaller, is 70 years old. The author is concerned with natural philosophy in the narrower sense. He characterizes it as "a scientific discipline which appears consciously by the side of and after natural science, not as a mere possibility after it, but as a necessity, simultaneously with it, demanded by it as an indispensable supplement."

This science, appearing by the side of the science of nature, he divides in two parts, to some extent overlapping in the case of individual authors, but still possible of juxtaposition: the metaphysical, which has the same object as science, namely nature, and is represented by Leibnitz, Goethe, Schelling, etc., and the critical, represented by Kant, Mach and the writers of the present day and whose object is not nature itself, but the science of nature.

After an introductory chapter dealing with the predecessors of Leibnitz: Copernicus, Paracelsus, Agrippa von Nettesheim, Jacob Boehme and Kepler, the author devotes one chapter to Leibnitz from whom he dates the continuous development of natural philosophy in Germany; after him come Kant and Fries, thereafter Herder, Goethe, Schelling and Schopenhauer, and after these follows a consideration of the opponents to the last mentioned: Herbart and Feuerbach. The next to the last chapter is given up to a consideration of the predecessors of the modern movement, Lotze and Fechner, while the last chapter is a summary treatment of the moderns, including a consideration of the influence of the Darwinian theory and the discussion that has taken place around it. In the latest modern development, Ostwald's "qualitative energetics," the author sees an interesting resurrection of Leibnitz's dynamism, though not directly descending from it.

In connection with this work it might be well to call attention to the organ of the modern natural philosophy, *Annalen der Naturphilosophie*, founded by Wilhelm Ostwald as an organ of the common ground of philosophy and natural science. With the volume for 1913 it takes the name *Annalen der Natur- und Kulturphilosophie*, which does not denote a further development of the plan of the journal, but characterizes more clearly its original aim and purpose. The volume now completed (1912) contains, like the previous ten, a number of interesting and significant articles, among which attention might be called particularly to G. C. Hirsch's "Goethe als Biologe," E. Dittrich's "Das Weltbild im Riemannschen Raum," the first installment of S. v. Prowazek's "Die organische Welt und Naturphilosophie." The editor contributed the initial article, an estimate of the life work of Ernst Abbe, called "Abbe unser Führer."—A. G. S. Josephson.

VOL. XXII. OCTOBER, 1913. NO. 4

THE MONIST

THE PHILOSOPHICAL IMPORTANCE OF MATHEMATICAL LOGIC.[1]

IN speaking of "mathematical logic," I use this word in a very broad sense. By it I understand the works of Cantor on transfinite numbers as well as the logical work of Frege and Peano. Weierstrass and his successors have "arithmetized" mathematics; that is to say, they have reduced the whole of analysis to the study of integer numbers. The accomplishment of this reduction indicated the completion of a very important stage, at the end of which the spirit of dissection might well be allowed a short rest. However, the theory of integer numbers cannot be constituted in an autonomous manner, especially when we take into account the likeness in properties of the finite and infinite numbers. It was, then, necessary to go farther and reduce arithmetic, and above all the definition of numbers, to logic. By the name "mathematical logic," then, I will denote any logical theory whose object is the analysis and deduction of arithmetic and geometry by means of concepts which belong evidently to logic. It is this modern tendency that I intend to discuss here.

In an examination of the work done by mathematical logic, we may consider either the mathematical results,

[1] [Lecture delivered in French at the School of advanced social studies (Ecole des Hautes Etudes Sociales) on March 22, 1911; translated by P. E. B. Jourdain from the *Revue de Métaphysique et de Morale*, Vol. XX, 1912, where it appears under the title, "L'Importance philosophique de la Logistique." This translation has been most kindly revised by Mr. Russell. The translator has added a few references in square brackets.]

the method of mathematical reasoning as revealed by modern work, or the intrinsic nature of mathematical propositions according to the analysis which mathematical logic makes of them. It is impossible to distinguish exactly these three aspects of the subject, but there is enough of a distinction to serve the purpose of a framework for discussion. It might be thought that the inverse order would be the best; that we ought first to consider what a mathematical proposition is, then the method by which such propositions are demonstrated, and finally the results to which this method leads us. But the problem which we have to resolve, like every truly philosophical problem, is a problem of analysis; and in problems of analysis the best method is that which sets out from results and arrives at the premises. In mathematical logic it is the conclusions which have the greatest degree of certainty: the nearer we get to the ultimate premises the more uncertainty and difficulty do we find.[2]

From the philosophical point of view, the most brilliant results of the new method are the exact theories which we have been able to form about infinity and continuity. We know that when we have to do with infinite collections, for example the collection of finite integer numbers, it is possible to establish a one-to-one correspondence between the whole collection and a part of itself. For example, there is such a correspondence between the finite integers and the even numbers, since the relation of a finite number to its double is one-to-one. Thus it is evident that the number of an infinite collection is equal to the number of a part of this collection. It was formerly believed that this was a contradiction; even Leibniz, although he was a partisan of the actual infinite, denied infinite *number* because of this supposed contradiction. But to demonstrate that there is

[2] [Cf. A. N. Whitehead and B. Russell, *Principia Mathematica*, Vol. I. Cambridge, 1910, pp. v-vi.—Tr.]

a contradiction we must suppose that all numbers obey mathematical induction. To explain mathematical induction, let us call by the name "hereditary property" of a number a property which belongs to $n+1$ whenever it belongs to n. Such is, for example, the property of being greater than 100. If a number is greater than 100, the next number after it is greater than 100. Let us call by the name "inductive property" of a number a hereditary property which is possessed by the number zero. Such a property must belong to 1, since it is hereditary and belongs to 0; in the same way, it must belong to 2, since it belongs to 1; and so on. Consequently the numbers of daily life possess every inductive property. Now, amongst the inductive properties of numbers is found the following. If any collection has the number n, no part of this collection can have the same number n. Consequently, if all numbers possess all inductive properties, there is a contradiction with the result that there are collections which have the same number as a part of themselves. This contradiction, however, ceases to subsist as soon as we admit that there are numbers which do not possess all inductive properties. And then it appears that there is no contradiction in infinite number. Cantor has even created a whole arithmetic of infinite numbers, and by means of this arithmetic he has completely resolved the former problems on the nature of the infinite which have disturbed philosophy since ancient times.

The problems of the *continuum* are closely connected with the problems of the infinite and their solution is effected by the same means. The paradoxes of Zeno the Eleatic and the difficulties in the analysis of space, of time, and of motion, are all completely explained by means of the modern theory of continuity. This is because a non-contradictory theory has been found, according to which the continuum is composed of an infinity of distinct ele-

ments; and this formerly appeared impossible. The elements cannot all be reached by continual dichotomy; but it does not follow that these elements do not exist.

From this follows a complete revolution in the philosophy of space and time. The realist theories which were believed to be contradictory are so no longer, and the idealist theories have lost any excuse there might have been for their existence. The flux, which was believed to be incapable of analysis into indivisible elements, shows itself to be capable of mathematical analysis, and our reason shows itself to be capable of giving an explanation of the physical world and of the sensible world without supposing jumps where there is continuity, and also without giving up the analysis into separate and indivisible elements.

The mathematical theory of motion and other continuous changes uses, besides the theories of infinite number and of the nature of the continuum, two correlative notions, that of a *function* and that of a *variable*. The importance of these ideas may be shown by an example. We still find in books of philosophy a statement of the law of causality in the form: "When the same cause happens again, the same effect will also happen." But it might be very justly remarked that the same cause never happens again. What actually takes place is that there is a constant relation between causes of a certain kind and the effects which result from them. Wherever there is such a constant relation, the effect is a function of the cause. By means of the constant relation we sum up in a single formula an infinity of causes and effects, and we avoid the worn-out hypothesis of the *repetition* of the same cause. It is the idea of functionality, that is to say the idea of constant relation, which gives the secret of the power of mathematics to deal simultaneously with an infinity of data.

To understand the part played by the idea of a function in mathematics, we must first of all understand the method of mathematical deduction. It will be admitted that mathematical demonstrations, even those which are performed by what is called mathematical induction, are always deductive. Now, in a deduction it almost always happens that the validity of the deduction does not depend on the subject spoken about, but only on the form of what is said about it. Take for example the classical argument: All men are mortal, Socrates is a man, therefore Socrates is mortal. Here it is evident that what is said remains true if Plato or Aristotle or anybody else is substituted for Socrates. We can, then, say: If all men are mortal, and if x is a man, then x is mortal. This is a first generalization of the proposition from which we set out. But it is easy to go farther. In the deduction which has been stated, nothing depends on the fact that it is men and mortals which occupy our attention. If all the members of any class α are members of a class β, and if x is a member of the class α, then x is a member of the class β. In this statement, we have the pure logical form which underlies all the deductions of the same form as that which proves that Socrates is mortal. To obtain a proposition of pure mathematics (or of mathematical logic, which is the same thing), we must submit a deduction of any kind to a process analogous to that which we have just performed, that is to say, when an argument remains valid if one of its terms is changed, this term must be replaced by a variable, i. e., by an indeterminate object. In this way we finally reach a proposition of pure logic, that is to say a proposition which does not contain any other constant than logical constants. The definition of the *logical constants* is not easy, but this much may be said: A *constant* is *logical* if the propositions in which it is found still contain it when we try to replace it by a variable.

More exactly, we may perhaps characterize the logical constants in the following manner: If we take any deduction and replace its terms by variables, it will happen, after a certain number of stages, that the constants which still remain in the deduction belong to a certain group, and, if we try to push generalization still farther, there will always remain constants which belong to this same group. This group is the group of logical constants. The logical constants are those which constitute pure form; a formal proposition is a proposition which does not contain any other constants than logical constants. We have just reduced the deduction which proves that Socrates is mortal to the following form: "If x is an α, then, if all the members of α are members of β, it follows that x is a β." The constants here are: *is-a, all,* and *if-then.* These are logical constants and evidently they are purely formal concepts.

Now, the validity of any valid deduction depends on its form, and its form is obtained by replacing the terms of the deduction by variables, until there do not remain any other constants than those of logic. And conversely: every valid deduction can be obtained by starting from a deduction which operates on variables by means of logical constants, by attributing to variables definite values with which the hypothesis becomes true.

By means of this operation of generalization, we separate the strictly deductive element in an argument from the element which depends on the particularity of what is spoken about. Pure mathematics concerns itself exclusively with the deductive element. We obtain propositions of pure mathematics by a process of *purification.* If I say: "Here are two things, and here are two other things, therefore here are four things in all," I do not state a proposition of pure mathematics because here particular data come into question. The proposition that I have stated is an *application* of the general proposition: "Given

any two things and also any two other things, there are four things in all." The latter proposition is a proposition of pure mathematics, while the former is a proposition of applied mathematics.

It is obvious that what depends on the particularity of the subject is the verification of the hypothesis, and this permits us to assert, not merely that the hypothesis implies the thesis, but that, since the hypothesis is true, the thesis is true also. This assertion is not made in pure mathematics. Here we content ourselves with the hypothetical form: *If* any subject satisfies such and such a hypothesis, it will also satisfy such and such a thesis. It is thus that pure mathematics becomes entirely hypothetical, and concerns itself exclusively with any indeterminate subject, that is to say with a *variable*. Any valid deduction finds its form in a hypothetical proposition belonging to pure mathematics; but in pure mathematics itself we affirm neither the hypothesis nor the thesis, unless both can be expressed in terms of logical constants.

If it is asked why it is worth while to reduce deductions to such a form, I reply that there are two associated reasons for this. In the first place, it is a good thing to generalize any truth as much as possible; and, in the second place, an economy of work is brought about by making the deduction with an indeterminate x. When we reason about Socrates, we obtain results which apply only to Socrates, so that, if we wish to know something about Plato, we have to perform the reasoning all over again. But when we operate on x, we obtain results which we know to be valid for every x which satisfies the hypothesis. The usual scientific motives of economy and generalization lead us, then, to the theory of mathematical method which has just been sketched.

After what has just been said it is easy to see what must be thought about the intrinsic nature of propositions

of pure mathematics. In pure mathematics we have never to discuss facts that are applicable to such and such an individual object; we need never know anything about the actual world. We are concerned exclusively with variables, that is to say, with any subject, about which hypotheses are made which may be fulfilled sometimes, but whose verification for such and such an object is only necessary for the *importance* of the deductions, and not for their truth. At first sight it might appear that everything would be arbitrary in such a science. But this is not so. It is necessary that the hypothesis *truly* implies the thesis. If we make the hypothesis that the hypothesis implies the thesis, we can only make deductions in the case when this new hypothesis truly implies the new thesis. Implication is a logical constant and cannot be dispensed with. Consequently we need *true* propositions about implication. If we took as premises propositions on implication which were not true, the consequences which would appear to flow from them would not be truly implied by the premises, so that we would not obtain even a hypothetical proof. This necessity for *true* premises emphasizes a distinction of the first importance, that is to say the distinction between a premise and a hypothesis. When we say "Socrates is a man, *therefore* Socrates is mortal," the proposition "Socrates is a man" is a *premise*; but when we say: *"If* Socrates is a man, *then* Socrates is mortal," the proposition "Socrates is a man" is only a hypothesis. Similarly when I say: "If from p we deduce q and from q we deduce r, then from p we deduce r," the proposition "From p we deduce q and from q we deduce r" is a hypothesis, but the whole proposition is not a hypothesis, since I affirm it, and, in fact, it is true. This proposition is a rule of deduction, and the rules of deduction have a twofold use in mathematics: both as premises and as a method of obtaining consequences of the premises. Now, if the rules of deduc-

tion were not true, the consequences that would be obtained by using them would not truly be consequences, so that we should not have even a correct deduction setting out from a false premise. It is this twofold use of the rules of deduction which differentiates the foundations of mathematics from the later parts. In the later parts, we use the same rules of deduction to deduce, but we no longer use them immediately as premises. Consequently, in the later parts, the immediate premises may be false without the deductions being logically incorrect, but, in the foundations, the deductions will be incorrect if the premises are not true. It is necessary to be clear about this point, for otherwise the part of arbitrariness and of hypothesis might appear greater than it is in reality.

Mathematics, therefore, is wholly composed of propositions which only contain variables and logical constants, that is to say, purely formal propositions—for the logical constants are those which constitute form. It is remarkable that we have the power of knowing such propositions. The consequences of the analysis of mathematical knowledge are not without interest for the theory of knowledge. In the first place it is to be remarked, in opposition to empirical theories, that mathematical knowledge needs premises which are not based on the data of sense. Every general proposition goes beyond the limits of knowledge obtained through the senses, which is wholly restricted to what is individual. If we say that the extension of the given case to the general is effected by means of induction, we are forced to admit that induction itself is not proved by means of experience.[3] Whatever may be the exact formulation of the fundamental principle of induction, it is evident that in the first place this principle is general, and

[3] [On induction and the principle of induction, cf. also B. Russell, *The Problems of Philosophy*, London and New York, 1912, pp. 93-108—Tr.]

in the second place that it cannot, without a vicious circle, be itself demonstrated by induction.

It is to be supposed that the principle of induction can be formulated more or less in the following way. If we are given the fact that any two properties occur together in a certain number of cases, it is more probable that a new case which possesses one of these properties will possess the other than it would be if we had not such a datum. I do not say that this is a satisfactory formulation of the principle of induction; I only say that the principle of induction must be like this in so far as it must be an absolutely general principle which contains the notion of probability. Now it is evident that sense-experience cannot demonstrate such a principle, and cannot even make it probable; for it is only in virtue of the principle itself that the fact that it has often been successful gives grounds for the belief that it will probably be successful in the future. Hence inductive knowledge, like all knowledge which is obtained by reasoning, needs logical principles which are *a priori* and universal. By formulating the principle of induction, we transform every induction into a deduction; induction is nothing else than a deduction which uses a certain premise, namely the principle of induction.

In so far as it is primitive and undemonstrated, human knowledge is thus divided into two kinds: knowledge of particular facts, which alone allows us to affirm existence, and knowledge of logical truth, which alone allows us to reason about data. In science and in daily life the two kinds of knowledge are intermixed: the propositions which are affirmed are obtained from particular premises by means of logical principles. In pure perception we only find knowledge of logical truths. In order that such a knowledge be possible, it is necessary that there should be self-evident logical truths, that is to say, truths which are known without demonstration. These are the truths

which are the premises of pure mathematics as well as of the deductive elements in every demonstration on any subject whatever.

It is, then, possible to make assertions, not only about cases which we have been able to observe, but about all actual or possible cases. The existence of assertions of this kind and their necessity for almost all pieces of knowledge which are said to be founded on experience shows that traditional empiricism is in error and that there is *a priori* and universal knowledge.

In spite of the fact that traditional empiricism is mistaken in its theory of knowledge, it must not be supposed that idealism is right. Idealism—at least every theory of knowledge which is derived from Kant—assumes that the universality of *a priori* truths comes from their property of expressing properties of the mind:[4] things appear to be thus because the nature of the appearance depends on the subject in the same way that, if we have blue spectacles, everything appears to be blue. The categories of Kant are the colored spectacles of the mind; truths *a priori* are the false appearances produces by those spectacles. Besides, we must know that everybody has spectacles of the same kind and that the color of the spectacles never changes. Kant did not deign to tell us how he knew this.

As soon as we take into account the consequences of Kant's hypothesis, it becomes evident that general and *a priori* truths must have the same objectivity, the same independence of the mind, that the particular facts of the physical world possess. In fact, if general truths only express psychological facts, we could not know that they would be constant from moment to moment or from person to person, and we could never use them legitimately to deduce a fact from another fact, since they would not

[4] It is possible that the true interpretation of Kant is less psychological than I supposed here; but the historical question has only a secondary importance for us in the present discussion. [Cf. also *ibid.*, pp. 127-141.—Tr.]

connect facts but our ideas about the facts. Logic and mathematics force us, then, to admit a kind of realism in the scholastic sense, that is to say, to admit that there is a world of universals and of truths which do not bear directly on such and such a particular existence. This world of universals must *subsist*, although it cannot *exist* in the same sense as that in which particular data exist.[5] We have immediate knowledge of an indefinite number of propositions about universals: this is an ultimate fact, as ultimate as sensation is. Pure mathematics — which is usually called "logic" in its elementary parts— is the sum of everything that we can know, whether directly or by demonstration, about certain universals.

On the subject of self-evident truths it is necessary to avoid a misunderstanding. Self-evidence is a psychological property and is therefore subjective and variable. It is essential to knowledge, since all knowledge must be either self-evident or deduced from self-evident knowledge. But the order of knowledge which is obtained by starting from what is self-evident is not the same thing as the order of logical deduction, and we must not suppose that when we give such and such premises for a deductive system, we are of opinion that these premises constitute what is self-evident in the system. In the first place self-evidence has degrees: It is quite possible that the consequences are more evident than the premises. In the second place it may happen that we are certain of the truth of many of the consequences, but that the premises only appear probable, and that their probability is due to the fact that true consequences flow from them. In such a case, what we can be certain of is that the premises imply all the true consequences that it was wished to place in the deductive system. This remark has an application to the foundations of mathematics, since many of the ultimate premises are

[5] [Cf. *ibid.*, pp 142-157.—Tr.]

intrinsically less evident than many of the consequences which are deduced from them. Besides, if we lay too much stress on the self-evidence of the premises of a deductive system, we may be led to mistake the part played by intuition (not spatial but logical) in mathematics. The question of the part of logical intuition is a psychological question and it is not necessary, when constructing a deductive system, to have an opinion on it.

To sum up, we have seen, in the first place, that mathematical logic has resolved the problems of infinity and continuity, and that it has made possible a solid philosophy of space, time, and motion. In the second place, we have seen that pure mathematics can be defined as the class of propositions which are expressed exclusively in terms of variables and logical constants, that is to say as the class of purely formal propositions. In the third place, we have seen that the possibility of mathematical knowledge refutes both empiricism and idealism,[6] since it shows that human knowledge is not wholly deduced from facts of sense, but that *a priori* knowledge can by no means be explained in a subjective or psychological manner.

B. RUSSELL.

TRINITY COLLEGE, CAMBRIDGE, ENGLAND.

[6] [Cf. *ibid.*, pp. 58-71.—Tr.]

CHRISTIAN ELEMENTS IN THE BHAGAVAD-GITA.*

NO other work of Sanskrit literature is so well known and so highly valued in India and the Occident as the Bhagavadgîtâ (Mbh., VI, 830 ff.), "The Song of the Exalted One," i. e., the solemn discourse of Krishna. Originally a text-book of the Bhâgavata sect, the Bhagavadgîtâ in time attained such a significance for all Brahman India that it has become the sum of all wisdom to the cultured Indian. In his contact with Christians he falls back on it as an authority against the New Testament, whose fundamental doctrines he believes to be contained in the Bhagavadgîtâ which in Hindu opinion is much the older. On the other hand European scholars have thought that no other Indian work bears such abundant evidence of Christian influence as the Bhagavadgîtâ. For these reasons I cannot limit myself simply to mention and discuss the points which have given rise to such statements. An exposition of the relations between Christianity and Brahmanism with reference to the history of religion requires a connected summary of the contents of the Bhagavadgîtâ[1] even though I must state most posi-

* Authorized translation from the German manuscript by Lydia G. Robinson. In the bibliographical references the following abbreviations will be observed: ERE, *Encyclopaedia of Religion and Ethics*; IA, *Indian Antiquary*; JAOS, *Journal of the American Oriental Society*; JRAS, *Journal of the Royal Asiatic Society.*

[1] I may be allowed to use for this purpose extracts from the exhaustive introduction to my translation of the Bhagavadgîtâ (Leipsic, 1905).

tively that the oft asserted dependence of the Indian poem upon the New Testament is only an apparent one.

After a feud of many years' duration, the two closely related but hostile tribes of the Kauravas and Pândavas with their military forces and allies advance to battle against each other on the field of the Kurus near where Delhi now stands. A mighty crashing of shells, drums and trumpets resounds, and arrows begin to fly from both camps. Then Arjuna, the famous archer of the Pândavas, catches sight of some of his kinsmen in the enemy's army, is shocked at the thought of killing them and lets fall his bow and arrows, because he would rather die than to fight and win under such circumstances. But Krishna, who stands at his side in human form as charioteer on the war chariot, admonishes him to do his duty without considering consequences and convinces him that he must take part in the battle.

These admonitions and instructions of Krishna become more and more profound and treat in sublime diction—in many places with rare beauty and loftiness of expression —the highest questions about the nature of deity and man's relation to it. Upon the foundation of metaphysical speculation is here erected a sublime ethical code. Gradually Arjuna perceives who is speaking to him. Krishna reveals himself to Arjuna as the only God, the Lord of all worlds, who has taken upon himself the form of the hero of the Yâdava tribe, and in the eleventh song at Arjuna's request shows himself in his celestial radiant form penetrating the entire world.

It has long been known that we do not possess the Bhagavadgîtâ in its original text, but in a form which is the result of substantial transformations. The teachings put into the mouth of Krishna in the Bhagavadgîtâ offer a remarkable mixture of pantheistic and monotheistic ideas,

of philosophical thought and of pure and deeply religious faith in God.

A personal God appears in human form, propounds his teachings, demands of the hearer before all else, besides fulfilment of duty, faithful love and submission to him, then reveals himself with special grace in his divine but still anthropomorphic form, and promises that after death as a reward for his love of God the faithful one shall enter into himself, shall attain communion with God. Along with this God, as personal as can be, who dominates the whole poem, there often stands as the highest principle the *impersonal* neutral Brahman, the Absolute. Sometimes Krishna says of himself that he is the only Supreme God who has made the world and all creatures, and governs the All; sometimes he proclaims the pantheistic doctrine of the Brahman and the Mâyâ, the cosmic illusion, and places before man as his highest aim, that he should overcome Mâyâ and become Brahman.

These two doctrines, the theistic and pantheistic, are dovetailed into each other and follow sometimes very directly and sometimes with a loose sort of connection. Nor is the one set forth as the lower, exoteric, and the other as the higher, esoteric doctrine; it is not taught that theism is the preparatory step to knowledge or the symbol of truth, and that pantheism is truth itself; but both forms of faith are treated almost without exception as if there were no distinction between them either as regards value or content.

The attempt has been made to do away with the contradictions in the Bhagavadgitâ by explaining that no definite system is here propounded, but that it is a poet who speaks, who takes the thoughts and forms them as they crowd upon him without regarding the contradictions which may arise in separate details.

But the great contradiction extending through the

Bhagavadgîtâ can not be set aside by appealing to the poetic temperament. It can only be removed by the assumption that one of the two heterogeneous doctrines which Krishna proclaims in the Bhagavadgîtâ must be a later addition. Therefore Adolf Holtzmann has upheld the view that the Bhagavadgîtâ was originally a purely pantheistic poem and that later it was worked over by worshipers of Vishnu-Krishna whereby it attained its present form. But this also is a mistaken view; the reverse is true. The whole character of the poem is so overwhelmingly theistic both with regard to setting and method, that we must suppose that the Bhagavadgîtâ was from the start a purely theistic poem and was worked over in the pantheistic spirit after the Brahmans had succeeded in winning over the religious community of the Bhâgavatas, the worshipers of Krishna, by identifying Krishna with their god Vishnu who had already become the All-God.

In the ancient poem Krishna speaks of himself—and Arjuna of Krishna—as of an individual, a person, a conscious divinity; in the additions of the redaction the neutral Brahman appears as the highest conception and is occasionally identified with Krishna. In short, *in the ancient poem Krishnaism is set forth which is founded philosophically upon the Sânkhya and Yoga systems; in the additions of the redaction Brahmaism is represented, the forerunner of the system of the Vedânta.* It has long been known that the doctrines of the Sânkhya-Yoga are on the whole the foundation of the philosophical doctrines of the Bhagavadgîtâ, and that compared to them Brahmaism remains considerably in the background. Because of this conviction I have sought in my translation of the Bhagavadgîtâ to select the original form of the poem and have eliminated the additions of the Brahmaistic revision.

The view which I here submit and my corresponding

attempt to a reconstruction of the original Bhagavadgîtâ have met with some opposition but still with more assent, among others from such eminent scholars as Sir George Grierson and Winternitz. Winternitz says[2]: "If we read the poem omitting the passages set off in small print by Garbe in his translation, the result is that there is no gap and that even in many places an interrupted connection is again established by leaving out the verses so indicated. It speaks on the whole in favor of the correctness of Garbe's conception that among the 170 verses cut out by him perhaps ten or twelve at the most can be named which show evidence of any poetical beauty." I myself had not noticed this esthetic consideration, but subsequently became convinced that the Bhagavadgîtâ in my reconstruction far exceeded the traditional text in poetical beauty and unity and must be recognized as the work of a genuine poet.

I will now first present as briefly as possible the doctrines of *the genuine original Bhagavadgîtâ*, i. e., the Bhâgavata faith worked out from the elements of the Sânkhya-Yoga with some new interpretations. In doing this it is not advisable to follow the train of thought of the Bhagavadgîtâ which wanders from one thing to another and constantly confuses the various established standpoints especially in the practical requirements. The religious content of the Bhagavadgîtâ corresponds to the Nârâyaniya section of the Mahâbhârata (XII, chapters 336-353), the second ancient text-book of the Bhâgavatas, except that the latter is somewhat more strongly Brahmaistic than the Bhagavadgîtâ.

[2] *Geschichte der indischen Litteratur*, I, 373. Cf. also *Wiener Zeitschrift für die Kunde des Morgenlandes*, XXI, 196, 197. I would like to utilize this opportunity to make a concession. I consider it very possible that Winternitz is right when in agreement with W. von Humboldt he feels obliged to consider as mainly later additions, besides the verses I have omitted, the last songs of the Bhagavadgîtâ which compare very unfavorably with the first twelve. By this means the scope of the original Bhagavadgîtâ is still further materially diminished.

As an introduction to my exposition, I must say in advance a few words about the conditions under which the adornment of the Bhâgavata religion with the above mentioned philosophical arguments took place.[3] When, according to the genuinely Indian tendency to fuse religion and philosophy, under the especial instigation of the strongly speculative influence of the Kshatriya caste, the effort was made to give a philosophical basis to the monotheism of the Bhâgavata religion, the pantheism which found expression in the older Upanishads was not chosen for this purpose. The home of this pantheism, the doctrine of the Brahman or the All-One, was the so-called "midland" (*Madhyadesha,* the region around and north of Delhi), the home of the Brahmanic civilization and expansion of power. The Brahmanic pantheism fitted but poorly with the popular monotheism of the Bhâgavatas who therefore directed their attention to the philosophical systems which had arisen "in the freer atmosphere of the less Brahmanized outland"—to use Grierson's happy expression—, the Sânkhya and Yoga. Of these two the Sânkhya, purely atheistic and regardless of ethics, was not sufficient for their purpose; for this system could be used by the Bhâgavatas only in the development of the doctrine of matter and its relation to spirit. Since the religion of the Bhâgavatas possessed faith in God and a pronounced ethical character its followers were better served by clinging more closely to the Yoga system which recognized God and pursued ethical tendencies.

The Yoga system is a daughter of the Sânkhya. It has adopted all the important Sânkhya views except its denial of God, and upon these has built up its doctrine of the concentration of thought and the powers to be won thereby. The personal God is inserted into the Yoga system in a very loose and disconnected way and the suppo-

[3] Cf. for the following, Grierson, article "Bhakti-Mârga," ERE, II, 541 *a*.

sition is not unjustified that this insertion has been unde taken in the interest of the union with the Bhâgavata r ligion; for thus did the system intended originally on for the comprehension of scholars, gain an influence ov wider circles. The Bhâgavatas on their side borrowe several concepts from the Yoga system, especially that c the Yoga or the concentration of thought which they grac ually transformed in the sense of submission to God, an approximated to the conception of the love of God.[4]

I shall begin my analysis of the doctrine of the Bhaga vadgîtâ with the *systematic* part, and start with the pe sonality of God. God is a conscious, eternal and omnip tent being, the "great Lord of the world without a begi ning" (X, 3). He is not only different from the perishab universe but also from the imperishable spirit of the b ings (XV, 17-19), hence spirit in another and a highe form than the souls of all creatures. When we read i VII, 4-6 that God possesses two natures, a higher spiritu nature through which the world is preserved, and a lowe material nature consisting of everything that accordin to the Sânkhya belongs to *prakriti* or matter, we must n understand by this that matter constitutes one-half of God essence. Rather does it mean that matter itself is not i dependent, following its own blind impulses, but unfol under the direction of God; in other words, that God op rates in matter and acts through it. This is establishe beyond doubt in other passages of the Bhagavadgîtâ. G implants in matter the germ of development (XIV, 3, and hence is the father of all creatures, whereas matt may be compared to the mother's womb (XIV, 4). G directs the origin, development, and dissolution of the u verse (IX, 7, 8, 10) and in this sense he calls himself t beginning and the end of the whole world (VII, 6; X,

[4] The significance of the Yoga system for the Bhâgavata religion is clearly apparent in the legend of Akrûra, Bhâg. Pur., X, 57, 29, in Grier IA, 1908, p. 257, Note 25.

and identifies himself with death (XI, 32). All conditions of beings are derived from him (X, 4, 5), he directs their fate, i. e., rewards them according to their deeds, and so causes creatures in the course of life "to whirl around like figures on a puppet stage" (XVIII, 61). All God's actions are performed merely for the sake of the world; for himself there is no desire to be fulfilled, no purpose to be attained (III, 22, 24). "Whenever right is decreasing, and wrong is increasing," God who has existed from eternity and is imperishable, creates himself anew, i. e., assumes new forms of manifestation "for the protection of the good and the extermination of the wicked, in order to establish justice" (IV, 6-8). Because God's acts pertain always to the creation he governs and never arise from any selfish motive he is not bound by his acts (IV, 13, 14; IX, 9); hence he can never be entangled in the world's existence. The visionary description of God in Song XI is a dramatic adornment intended to work upon the imagination, but is of little importance for the teaching of the Bhagavadgîtâ proper.

The relation of God to the world of men is not only determined by the stern law of compensation, but *God loves the people who recognize him and submit to him with their whole hearts,* (VII, 17; XII, 14-20; XVIII, 64, 65, 69), *and he saves from all sins those who take their refuge in him alone* (XVIII, 66). Here (and likewise XVIII, 56, 58, 62, 73) *we already have faith in divine mercy* (*prasâda*) which we meet with in some later Upanishads and which consequently plays so conspicuous a part in the Indian sects.

Although God directs the dispensation of the universe, yet, as we have seen above, it is matter which performs all acts (III, 27; V, 14; XIII, 20, 29). The world develops from primitive matter and returns to it again (VIII, 18, 19); the idea of evolution and reabsorption as well as the

notion of the eons is borrowed from the Sânkhya system. On the whole all views pertaining to matter in the Bhagavadgîtâ agree with the Sânkhya doctrine. The three *gunas*, or constituents of matter,[5] play the same part here as in the Sânkhya system; i. e., by their influences they put the spirit in fetters (XIV, 5 ff.), and the consequences of their activity are manifest in life on every hand, as is shown in great detail in Songs XVII and XVIII. The physiological ideas about the internal organs and senses are likewise those of the Sânkhya system (III, 40, 42; XIII, 5). All these agreements, however, are not so important for the teaching of the Bhagavadgîtâ as the fundamental conception with regard to the nature of matter which was borrowed from the Sânkhya and from which starts the philosophical speculation in Song II. To be sure matter was not created by God, but has existed from the beginning, and is subject to constant change and transformation.

All its products and effects are transitory; its influences, especially joy and pain, come and go and hence do not deserve that we should allow ourselves to be regulated by them (II, 14).

In contrast to this mutability of everything that matter brings forth stands the immutability of *spirit*. The spirit (the soul, the self) resembles matter only in so far as both are eternal and indestructible; for what is has always been and always will be, "the non-existent knows no existence, the existent no non-existence" (II, 16); but the great contrast between matter and spirit consists in the fact that the latter is never capable of change. Indeed the spirit dwells in the body absolutely inactive, "neither acting nor causing to act" (V, 13-15) and remains unmoved by all influences and operations of matter. This is brought out in sublime language in the second song. Whosoever knows

[5] See my *Sânkhya-Philosophie*, 209-220, *et passim*; "Sânkhya und Yoga," *Grundriss der indo-arischen Philologie und Altertumskunde*, III, No. 4, pp. 19, 20.

that the spirit is the true self, that the worn-out body is abandoned and passes into a new one as old clothes are laid aside and new ones donned (II, 22), that the spirit can be neither injured nor destroyed—such a one does not lament over the suffering and death of a man, that is to say, over matters which concern only the perishable body.

All this is pure Sânkhya doctrine; but nevertheless the conception of the spiritual principle in the Bhagavadgîtâ is essentially different from that in the Sânkhya system, not exclusively philosophical but predominantly religious. According to the Bhagavadgîtâ, which proclaims the faith of the Bhâgavatas, the individual soul has not led a separate existence from the beginning, but has detached itself from the divine soul as a separate part (XV, 7; cf. also XVI, 18; XVII, 6). Hence the individual souls have a divine origin; they have entered into a connection with matter which is not able to produce any transformation in them but which has brought life and consciousness into the world. It is man's task so to conduct himself that his soul may return again to its origin, to God.

With this we come to the practical part of the doctrine of the Bhagavadgîtâ. Here stand the two opposing ways of salvation, one of which consists in withdrawing from worldly life and striving after knowledge, the other in acting according to duty apart from all desire. Although the second way is frequently characterized as the better one (III, 8; V, 2; XVIII, 7) and according to the whole context of the Bhagavadgîtâ is to be regarded as the particular moral ideal of the poem, still the author has not dared to disregard the path of salvation of world renunciation and abstract knowledge. The idea that salvation from the circuit of life is to be attained by meditation in complete isolation from the world had been for centuries so rooted in the thoughtful circles of the Indian people that it could not be seriously opposed. Nothing else remained

than to recognize both ways side by side and to teach that right action led to salvation as well as knowledge which presupposed the renunciation of works and inactivity. From the fact that in the Bhagavadgîtâ now one standpoint is advocated and now the other, and occasionally the ideal of quietism is frankly placed above that of activity (VI, 3), all sorts of inconsistencies and confusions have arisen which might have been avoided by the positive rejection of the quietistic standpoint. The two standpoints are assimilated with one another in the Bhagavadgîtâ by the explanation that the dutiful act performed entirely without reference to consequences and without any personal interest loses its effective power, and hence does not result in continued existence for the doer. Actions of this kind therefore in this respect have the same value as the inactivity of the way of salvation through knowledge.

The knowledge to be attained on the quietistic path of salvation is described in several passages (XIII, 23; XIV, 19) exactly in the sense of the Sânkhya system, as a distinction between spirit and matter; and as a result of this distinction the prospect of liberation from the necessity of rebirth is held out to the one who possesses this knowledge (XIII, 23) without reference to his conduct. This may be looked upon as an isolated recognition of the genuine Sânkhya ideal. In general the saving knowledge, according to the view of the Bhagavadgîtâ, is not limited to the distinction between spirit and matter, but this distinction may be regarded only as a preliminary condition of the *knowledge of God* which in truth leads man to supreme salvation.

The other path of salvation, the Yoga, conceived as disinterested fulfilment of duty, is preached in the Bhagavadgîtâ incessantly and in various ways. Fulfilment of duty alone would not lead to the goal as long as it is in the slightest respect accompanied by hope for the results. Man

should do what is commanded him without passion, with quietness and equanimity, feeling the same towards every one, esteeming of equal value pleasantness and unpleasantness, joy and pain, success and failure, without desire and without any personal interest. The works of him who acts with this disposition, without troubling himself about the transitory effects of material things (II, 14) solely according to the dictates of duty and following the divine example (III, 22) and leaving the results of all his work to God, are not subject to the law of compensation (IV, 22, 23; IX, 27, 28; XVIII, 12, 17). The requirements here set forth presuppose the condemnation of the Vedic ritual which in the original Bhagavadgîtâ is enunciated without any limitation. All the ceremonies of the Brahmanic ritual serve personal desires throughout and hence stand in sharp contrast to the ideal of morality of the Bhagavadgîtâ. "Give up all sacred usages," we therefore read in XVIII, 66, and in II, 42-45, outspoken scorn is shown for the promises of the Veda which take only the material world into account and offer only transitory rewards (cf. also IX, 20, 21). Accordingly indifference for the prescriptions of the Vedic ritual is likewise a preliminary condition for the attainment of salvation (II, 52, 53). That in this requirement also we have genuine Sânkhya-Yoga doctrine is clear to every one acquainted with the Indian systems.

Whichever of the two paths of salvation man may follow, in both cases he must overcome an obstacle in his natural disposition. When it is said in III, 33, that "beings follow their nature" and when in XVI, 1 ff. the distinction is made between men born for divine existence and those born for a demonic existence, this predetermination is to be understood as an effect of previous merit or of previous sin. In the Bhagavadgîtâ there is no question of predestination properly so called. Instead we can

recognize in it the assumption of moral freedom. Man is entirely free whether or not he will overcome the obstacles which lie upon the path to salvation, whether he strives after low aims or the highest. On the path to the latter innate ignorance stands opposed to the practice of knowledge (V, 15), and the likewise innate desire which is the peculiar enemy of mankind to the practice of duty (III, 37, 43); but unbelief and skepticism are also destructive (IV, 40). As an expedient toward the successful overcoming of these obstactles moderate Yoga exercises are recommended (V, 27, 28; VI, 10 ff.; VIII, 10, 12 ff.). Even if a man is not successful in mental concentration these Yoga exercises are nevertheless not in vain, for such a man is reborn under favorable circumstances and finally attains the supreme goal (II, 40; VI, 41 ff.).

We finally come to the most important requirement which the Bhagavadgîtâ makes of men in need of salvation. As is well known the Bhagavadgîtâ is the Canticles of *bhakti,* the faithful and confiding love of God. Both on the path of knowledge and on that of the self-denying fulfilment of duty, love to God leads to the goal with absolute certainty. The whole poem is filled with this thought; to proclaim this thought it was written. From the love of God arises the *knowledge of God* (XVIII, 55) and love of God likewise brings about that the faithful refer all works to God and leave the consequences to him. To every one without distinction of birth or of previous behavior bhakti vouchsafes the certainty of salvation—even to criminals, women, Vaishyas and Shûdras (IX, 30-32). But it is not a question of a passing impulse of love for God, but the whole nature of man must be filled with an unchangeable love. When this is the case man's thoughts are directed upon God even in the hour of death. Special weight is laid upon this point in the Bhagavadgîtâ (VIII, 5, 9, 10,

13) because man enters into that form of existence of which he is thinking in the hour of death (VIII, 6).

What now are we to understand of the condition of the soul which has been freed from the existence of the world and has entered into God? Are we to regard it as unconsciousness, as is taught in the Sânkhya-Yoga? Is the individuality of the soul which once separated itself from the divine soul, extinguished in the return to its origin? No! Salvation is thought of as a blessed condition of the soul which continues to exist in its individuality in the presence of God.

This has remained for all time a fundamental and leading doctrine of the Bhâgavata religion. God has caused all individual souls to go forth from himself to a separate conscious existence and since then they exist for all eternity as individual conscious beings. When they have won salvation from their worldly existence they do not become God but become like God and at his feet enjoy an everlasting bliss which consists solely in serving him.[6] How indeed on the assumption of the Sânkhya-Yoga a soul can lead a conscious existence without regard to matter, we learn neither from the Bhagavadgîtâ nor any other Bhâgavata work. Apparently we have here to do with a view which is derived from the earliest times of the Bhâgavata religion, and which ever since these times has formed one of the main props of this faith. Therefore in its adornment with elements of the Sânkhya-Yoga this view must not be supplanted by the opposite doctrine of the two systems. Pious conviction helped to do away with the difficulties of method which thus arose. In general, however, the religio-philosophical doctrines of the *original* Bhagavadgîtâ, as the above exposition shows, are of transparent clearness. This clearness is greatly impaired by the pantheistic redaction. The traditional form of the poem in

[6] Grierson, ERE, II, 544*a*.

which sometimes the personal God (Krishna) and sometimes the impersonal World Soul (the Brahman) appears as the supreme principle, and both are often identified, in which sometimes the conscious continued existence in the presence of God and sometimes the absorption into the world-soul is set up as the highest goal—is full of intrinsic contradictions.

Looking back we find in the Bhagavadgitâ the following agreements with Christian views:

1. Faith in God's love to man and in his mercy and forgiveness of sins arising therefrom;

2. The requirement laid upon man of faithful love to God, *bhakti*.[7]

From these agreements have arisen all sorts of similarities of New Testament modes of expression which very naturally suggested the thought of a loan.

Lorinser[8] has gone the farthest in pursuing this idea when with great decision he expresses his conviction, "that the author of the Bhagavadgîtâ not only was acquainted with the writings of the New Testament and made frequent use of them, but on the whole has woven into his system Christian ideas and views," "that this much admired monument of the spirit of ancient India, this most beautiful and loftiest didactic poem which can well be regarded as one of the noblest flowers of pagan wisdom, owes precisely its purest and most highly praised teachings for the most part to Christian sources" (page v). Lorinser even undertakes to show from what writings of the New Testament more and from what fewer "sentences are borrowed," that "all the epistles of St. Paul with the exception of those to the Thessalonians and to Philemon were utilized" (page 285), and the like.

No one to-day would dare draw such bold conclusions

[7] See above, pp. 501, 506.

[8] In the introduction, notes and appendix to his metrical translation of the Bhagavadgitâ, Breslau, 1869.

from such very indefinite similarities in thought and expression. Even Lorinser would certainly not have allowed his joy in discovery to carry him so far beyond all bounds if he had been more intimately acquainted with the Hindu thought cycles.[9] Even A. Weber, though always inclined to a great extent to believe in Christian influences upon India, thinks that Lorinser has greatly overestimated the weight of his argumentation, and that the question whether an acquaintance with the doctrines of Christianity must be assumed for the Bhagavadgîtâ, still continues to be *sub judice*.[10]

Almost all the other Indologues have completely rejected Lorinser's argumentation, last of all Winternitz[11] in whose opinion "not more than twenty-five of the more than one hundred parallel passages from the Gospels which Lorinser compares with passages of the Bhagavadgîtâ, are of such a kind that a loan would be *conceivable*. However, in no single case," Winternitz continues, "is the similarity so close that the assumption of a loan would be any more probable than that of an accidental agreement. Even love of God is not of course limited to Christianity. I will only mention Sufism in which it plays no less significant a part than with the Christian mystics."

But the best criticism of Lorinser's theory is furnished by the materials collected by John W. Robertson[12] who brings forward from the *pre-Christian* Greek and Roman literature passages which bear a much greater similarity to New Testament ideas than the verses of the Bhagavadgîtâ which Lorinser compares with them.

[9] A particularly striking proof of this deficiency in Lorinser I have mentioned in my translation of the Bhagavadgîtâ, page 105, Note 3.

[10] *Indische Literaturgeschichte*, 2d ed., 367.

[11] *Geschichte der indischen Litteratur*, I, 370, Note 3.

[12] *Christianity and Mythology*, London, 1900, 285, cited in van den Bergh van Eysinga, *Indische Einflüsse auf evangelische Erzählungen*, 2d ed., 21, Note 4.

Of all the Indologues Hopkins after his change of view[13] approaches most closely the standpoint of Lorinser. Hopkins[14] has collected a large number of parallels from the Bhagavadgîtâ and the New Testament and incidentally has ascribed particular significance to the circumstance that most of them are to be found in the Gospel of John. That in the narrow space of this Gospel so many parallels "partly of surprising similarity" stand side by side, seems to Hopkins in consideration of the more general agreements in the other Gospels, to be an almost conclusive proof of the dependence of the Bhagavadgîtâ. Hopkins explains the partiality for the Fourth Gospel alleged to be observed in the Bhagavadgîtâ from the fact that this Gospel—perhaps not uninfluenced by the gnosticism of that time—was peculiarly suited because of its mystical tone to cause the Indian theologians to borrow such expressions and thoughts as best fitted in with the conception of Krishna as a god of love.[15]

It would lead too far and would not be worth while to speak in detail of the parallels brought forward by Hopkins after I have already (July *Monist*) treated more particularly of the Christian similarities in other parts of the Mahâbhârata in which Hopkins considers a loan from the New Testament possible. All those similarities are satisfactorily explained from the intrinsic parallelism of the fundamental religious and philosophical conceptions of the Bhagavadgîtâ and the Gospel of John. We shall also see at once that the age of the Indian ideas precludes the assumption that they were borrowed from Christianity. First I will add that Paul Deussen in his translation of the Bhagavadgîtâ points out only in the following three verses the passages of the New Testament (in John and

[13] See "Christian Elements in the Mahâbhârata excepting the Bhagavadgîtâ," in *The Monist* of July, 1913, page 337, Note 33.

[14] *India Old and New*, 148-159.

[15] *India Old and New*, 155, 158.

Galatians) which are related in sense, without taking into consideration the possibility of a loan.

Bhag., IV, 4, 5. (After Krishna has told Arjuna that he has proclaimed to Vivasvat the imperishable doctrine of submission in the days of old, Arjuna asks): Later is thy birth, earlier the birth of Vivasvat; how am I to understand that thou hast proclaimed the doctrine before him? (Krishna answers): Many have been my past births....all of these I know, etc.	John, viii. 57, 58: Then said the Jews unto him, Thou art not yet fifty years old, and hast thou seen Abraham? Jesus said unto them, Verily, Verily I say unto you, Before Abraham was I am.
Bhag., IX, 29: I am the same to all creatures; no one is hateful to me and no one is dear. But those who are devoted to me in love are in me and I in them.[16]	John xiv. 20: At that day ye shall know that I am in my Father, and ye in me, and I in you.
Bhag., IX, 32: Even those, O Son of Prithâ, who are of lowly birth, women, Vaishyas and Shudras, will attain the highest aim, when they take their refuge in me.	Gal. iii. 28: There is neither Jew nor Greek, there is neither bond nor free, there is neither male nor female: for ye are all one in Christ Jesus.

I now come to the question, What on the whole is the historical possibility of the assumption of Christian influences upon the Bhagavadgîtâ? The traditional text belongs to a period in the development of the Mahâbhârata which with Hopkins[17] we must place in the time between 200 B. C. and 100-200 A. D. I had thought that I had ascertained for this text (i. e., for the redaction of the Bhagavadgitâ in the pantheistic sense), the second century after Christ and for the composition of the original

[16] Deussen might just as well have named as parallel passages to this verse of the Gospel of John the two following verses of the Bhagavadgîtâ, IV, 35: "Thou wilt not again, so fall into confusion, Oh Pândava, when thou hast attained the knowledge by which thou wilt perceive creatures without exception (first) in thyself and then in me;" and VI, 30: "Who sees me in all things and all things in me, from him will I not be lost nor will he be lost from me." It is clear that these verses of the Bhagavadgîtâ express the well-known fundamental view of Brahmaism. It is remarkable however that these parallels to John xiv. 20, which are closer than all other agreements with the New Testament brought forward from the Bhagavadgîtâ, are entirely lacking in Lorinser's lists of alleged loans.

[17] See the introduction to my translation of the Bhagavadgîtâ, 58 ff.

poem the second century before Christ.[18] A considerable interval must be assumed between the two compositions for the reason that in India they would not have dared until after considerable time had elapsed to transform by such a comprehensive revision and redaction a work which was considered a revelation of deity and was surrounded by the nimbus of the greatest sanctity. But there may be different opinions about the length to be assigned to this interval. However, for the question in hand the problem is of secondary importance since of course the adherents of the theory of Christian influence can insist that this influence was not felt until the revision of the Bhagavadgîtâ. If the date I have just assigned to the revision is correct it excludes the assumption of Christian influence, because at the very earliest Christianity penetrated into northwestern India at the beginning of the third century. Any *considerable* shifting of this date to a later time is excluded; nevertheless some scholars like Lassen, Weber, and John Davies place the composition of the text of the Bhagavadgîtâ as it has been handed down, in the third century, and for this time to be sure although we cannot grant the probability of Christian influence, there is nevertheless a remote possibility of it. Moreover since some specialists believe in the historical character of the legend of St. Thomas as far as it concerns the Indo-Iranian borderland and at the same time consider Christian influence possible as early as the first century, the proof for the love of God and a loving God in a pre-Christian age must be found here.

Scholarly Indians[19] claim that the religion of *bhakti*,

[18] My main reason for the latter date which I derived from the age of the Yoga-sûtras, pp. 62, 63 of my introduction) I can no longer maintain since H. Jacobi has proved in a keen and convincing fashion that the author of the Yogasûtras, Patañjali, is not identical with the grammarian of the same name and that he can not have written before 450 A. D. (JAOS, XXXI, 24 ff.).

[19] For instance R. G. Bhandarkar in his *Report on the Search for Sanskrit Manuscripts in the Bombay Presidency During the Year 1883-84*, Bombay, 1887, p. 74, near the bottom, and at the end of his lecture on "The Râmânu-

or faithful confiding love of God, has existed in India time out of mind. The statement is certainly not correct in this form for the reason that such a high degree of culture as is necessary to produce the idea of love of God never existed on earth in immemorial times; but still it contains an element of truth, for bhakti did not, as Grierson once erroneously said,[20] make its appearance directly and like a flash of lightning as something quite new whereby knowledge (of the alleged truth) has been forced out of its dominant position in religion, but in its beginnings and earliest impulses it may be traced back to ancient Vedic times.[21] In the Rigveda where the gods are often called father, brother, friend, etc. and are supplicated for health and protection in all sorts of expressions of childish confidence, the ancient poets were prompted to use these words from the same feelings that joined them to the human beings who were most closely related to them. When monotheistic tendencies had gained the upper hand, this old feeling of naive affection for the gods was gradually ennobled and exalted to a submissive, devout and confiding love of God which filled the whole personality. Love of God first became the pinnacle and center of religious life among the sect of the Bhâgavatas out of which Krishnaism arose; it seems also to have received the name *bhakti* among the Bhâgavatas as this word is derived from the same root as *Bhagavat* and *Bhâgavata*.

From Pânini's grammar (IV, 3, 95, 98) it follows that at the time of its composition *bhakti* was not only used in the secular sense of "love, submission, devotion," but that it was also applied to men's relations with God.

jiva and the Bhâgavata or Pâncharâtra Systems," before the Aryan section of the Congress of Orientalists at Vienna in 1888. See also B. C. Mazumdar, JRAS, 1910, 171.

[20] JRAS, 1907, 313 at the bottom. But he no longer holds this view in *ibid.*, 1910, 172; ERE, II, 539*b* at the bottom.

[21] Max Müller, *History of Ancient Sanskrit Literature*, 537 ff.

The connection of the word with Vâsudeva in rule 98 is a proof which is now indisputable since Grierson has definitely refuted Kielhorn's view that Vâsudeva in this passage is not the name of a god, but of a human person.[22] Heretofore it has been generally supposed that Pânini lived about 300 B. C., but there was not a positive proof for this date. Now from Jacobi's study of the Kautiliya[23] we know with certainty that Pânini was recognized as a grammatical authority as early as the fourth century B. C. Accordingly in its religious signification *bhakti,* because mentioned by Pânini, must have been a generally current concept in India about 400 B. C. Therefore it is not at all necessary to assign a later date to the Shvetâshvatara Upanishad because of its concluding verse, "He who feels the highest love to God (*yasya deve parâ bhaktih*) . . . ."

When Hopkins says[24]: "The doctrine of bhakti, faithful love as a means of salvation, can not be much older than the Song" (i. e., the Bhagavadgîtâ), we must on the contrary emphasize that it may have been proclaimed in the circle of Krishna worshipers centuries before the composition of the original Bhagavadgîtâ. A new doctrine is submitted differently than the bhakti in the Bhagavadgîtâ where this sentiment is required throughout as a matter of course. It is found also in the closest connection with the doctrine of devotion (*yoga*) which in the beginning of the fourth song Krishna expressly characterizes as very ancient.

The assumption that the use of the word *bhakti* in its

[22] JRAS, 1909, 1122. See also R. G. Bhandarkar, *loc. cit.*, 1910, 168-170. Edmund Hardy, in the *Lit. Centralblatt*, 1903, col. 1269, has further called attention to the fact that *bhakti* (in the Pâli form *bhatti*) appears in Jâtaka V, 340, 3, 6, and 352, 11, denoting "love, devotion," and with regard to the transition to the specific meaning, love of God, has referred to Theragâthâ, verse 370. Hence we have here from the far south a further proof that the Indian idea of the love of God is older than Christianity.

[23] *Sitzungsberichte der K. Preussischen Akademie der Wissenschaften*, 1911, XLIV, 966.

[24] *Religions of India*, 429.

specifically religious sense has been brought about by a conception borrowed from Christianity ought not to require any further refutation. The idea was very improbable from the first because distinct traces of the religious sentiment which Hindus call *bhakti* are to be found also in the Greek and Roman religions in pre-Christian times.[25] In this respect the Indians, who from the earliest days have always taken the salvation of the soul more seriously than most other peoples, have certainly not remained behind the Greeks and Romans in development.

The idea of Krishna as a loving God must also have been as old as that of the love of God; for each of these ideas is dependent on the other. Only a loving God could demand love. But a loving God also shows mercy and by forgiving sins delivers from perdition otherwise unavoidable. Although *prasâda,* the usual word for the grace of God first appears in the later Upanishads[26] and in the passages of the Bhagavadgitâ cited above (p. 501), yet the idea of divine grace itself is much older. Without it the countless prayers of the Vedic poets for all manner of divine favors would not have been possible. Hopkins[27] instances as a particularly characteristic case the verse in the Rigveda (10, 125, 5) where speech (Vâch) personified as a goddess declares "Whom I love I shall make a man of power, a priest, a seer, a sage."

Hand in hand with the victorious advance of the monotheistic faith in a loving God must have gone the development of the doctrine of his grace. "The doctrine of *prasâda,* or grace, has formed an essential part of the Bhâgavata religion so far back as literature takes us," says Grier-

[25] Barth, *Religions de l'Inde,* 132; A. Berriedale Keith, JRAS, 1907, 490.

[26] Kath., 1, 2, 20; Shvet., 3, 20; 6, 21; Mund., 3, 2, 3 (Hopkins, *Great Epic,* 188). It is probable that we have here a loan from the Bhâgavata religion since the idea of mercy does not harmonize with the Upanishad doctrine of the pantheistic Brahman. Grierson, IA, 1908, 260, Note 34.

[27] *India Old and New,* 147 note.

son,[28] and in this connection he emphasizes most decisively that India owes the idea of a God of mercy, of a kind father, to the Bhâgavatas.

The seemingly Christian coloring of the Bhagavadgitâ and of those later portions of the Mahâbhârata whose contents are akin to it, must therefore in consideration of all that I have here set forth be characterized as an outgrowth of genuine Indian religious feeling.

RICHARD GARBE.

UNIVERSITY OF TÜBINGEN.

[28] In the article "Bhakti-Mârga," ERE, II, 543*b* note.

THE ACCESSIBILITY OF BUDDHIST LORE TO THE CHRISTIAN EVANGELISTS.

THE great difficulty in the way of Christian scholars accepting the fact of Buddhist elements in the Gospels is our ignorance of the extent of Buddhism at the time of Christ.

We imagine that before Luke and John could quote a Buddhist text they would have had to learn Sanskrit or Pali! But in view of recent discoveries no such wild fancy can any longer be. We now know from existing evidence that there were at the time of Christ the following sources of information about Buddhism accessible to the Evangelists:

1. Scenes in Buddha's life pictured in stone upon temples at Bharahat, Sâñci (probably), and Anurâdhapura. The first two remain to-day, while the list of life-scenes at the third is preserved in the *Great Chronicle* of Ceylon. As travelers were coming and going continually, some account of these sculptures was accessible to studious men in cities like Rome, Antioch and Alexandria.

2. Buddhist texts translated into Sogdian and Tokharish, two dialects understood by the Parthians who were present at Pentecost.[1]

3. Lives of Buddha, manuals and elementary books on Buddhism known to have been translated into Chinese from

[1] See my article, "The Progress of Buddhist Research," in *Mahâ Bodhi Journal*, July, 1912.

the first century onward, and which it is reasonable to infer that the Buddhist missionaries had already translated into Tokharish and Sogdian, because the religion was in Bactria and probably in Parthia before it was in China.

4. Buddhist folk-tales which traveled orally or even in writing, and which were sculptured in abundance upon the temples already named. Hindu fairy tales have been traced by Jacobs in the Talmud, and one has lately been found scribbled upon an Egyptian vase of the first century.[2]

We are only following the methods of science followed by Adams and Leverrier as they watched for the planet Neptune, when we reason from the known to the unknown and infer that Matthew and Luke were using a Buddhist source in their story of the Lord's three temptations:

1. Temptation to assume empire,
2. Temptation to transmute matter,
3. Temptation to commit suicide.

I have shown in my article in *The Monist* for January, 1912,[3] that our Gospels agree more closely with the Buddhist temptation story than with the Zoroastrian, though the latter was nearer, both geographically and theologically. In our present recensions of the Buddhist scriptures, in Pali and Chinese, these three temptations do not occur all together as in the Gospels, but two of them in a five-volume work and another in a three-volume work. This is the basis upon which Louis de la Vallée Poussin tells his clerical readers that I believe that Luke had the Classified and Long Collections (eight volumes) before him when framing his story of the Temptation![4] Many

[2] W. Max Müller, the Egyptologist, tells me this.

[3] In reply to this article, Professor Garbe, in *The Monist* of July, 1912, p. 478, made the generous admission that I had heightened the probability of the loan hypothesis.

[4] *Revue des sciences philosophiques et théologiques*: Kain, Belgium, 1912, (Article: "Les religions de l'Inde et l'Apologétique"). To complete the joke, La Vallée should have added that, in my belief, Luke was a subscriber to the Pali Text Society of Alexandria.

an ecclesiastic has doubtless enjoyed a laugh over this, as indeed I have enjoyed it myself. But in order to avoid this very hypothesis I had pointed out, in an article in *The Open Court* for January, 1912, that there were at the time of Christ numerous lives of Buddha, manuals and elementary treatises on Buddhism. We know this from Chinese catalogues of Buddhist literature which represent the Hindu, Bactrian and Parthian Buddhist books of the first century.

Moreover, there were numerous recensions of the Scriptures including the Book of Temptations. Eighteen sects, says the *Island Chronicle* of Ceylon, had each its own recension of the canon and swore that it was the right one. Now it is a very simple inference from known facts about the diversified arrangement of Buddhist texts, that there was at the time of Christ a recension of the Book of Temptations wherein all three temptations occurred together. It is practically certain that such was the case, for in the Suicide Temptation (late in Buddha's life) the Decease Book indicates that the same temptation had been made before, and that Buddha had given the Devil the same reply. In our present recensions of the Book of Temptations, in Pali and Chinese, this earlier suicide temptation is lacking.

In my *Monist* article, I adduced the angelic heralds and their hymn in Luke ii as a probable Buddhist loan. I should now like to add that the crucial words "For weal and welfare in the world of men" (Luke's well-known Christmas peace and good-will) were sculptured in substance upon the Girnâr Rock in the third century before Christ:

"The White Elephant who is called Bringer of Happiness to all the world!"

Christ was symbolized as a white and gentle lamb, and Buddha was symbolized as a white and gentle elephant.

He antedated Christ by several centuries as the first conception of a world-Messiah (unless our Mazdean friends can prove that Zoroaster was so conceived).

Besides Asoka's inscription at Girnâr, we have lately found one by Kanishka at Peshawar, wherein the words occur:

"Let it be for the weal and welfare and benefit of all beings!"

Among the scenes which were favorites to be sculptured upon topes, none was more prominent than the legend of Prince Workman-quarter, known in Pali as the *Vessantara Jâtaka*. According to this widespread folk-tale, the Buddha, in a former incarnation, was born in the workman's quarter of a capital and grew up to be a great philanthropist. He gave all he had away, including a magic rain-bringing elephant, and for this crime against the state he was banished. At last he gave even wife and children away, but, like Job, was restored to his former happiness.

Now this very story, which is at Bharahat, Sâñci, Ajaṇtâ, Amarâvati, and has lately been found by Aurel Stein at Miran in Chinese Turkestan, was also graven upon the Anurâdhapura tope; and visitors from Alexandria came to the opening ceremonies in the second century before Christ. To crown all, the desert sands have just now yielded up a copy of the story in Sogdian, so that there was no excuse for an Antioch physician or an Ephesian Philonist, who were well versed in religious lore, to be ignorant of it. Sogdian was probably meant by Strabo when he said that nearly the same language pervaded Media and parts of Persia, Bactria and Sogdiana. And students of religion must have known about the great faith whose books were being translated by missionaries into the tongues of a neighboring empire.

I will end by translating from the Pali (Jâtaka 547 and

last) the vow of the former Buddha to sacrifice himself for mankind:

"When I was a child but eight years old,
Then, lying in my palace, I thought thus
upon gifts and giving:
My heart would I give, mine eye,
my flesh or my blood;
I would press out my body and give it
if any one should ask me!"

In the Sogdian version, just translated into French by Gauthiot, the vow is much nearer to Christian ideas; and it belongs to the research of the future to determine whether the story was rewritten under Nestorian influence in Central Asia, or whether these Mahâyâna ideas were not already developed by the time of Christ.

The Sogdian vow runs thus:

"May I obtain the quality of a Buddha; may I deliver from hell the living beings of the five forms of existence in the three worlds; may I disenthral them from evil; may I fasten the gates of hell; extricate from sufferings the living beings guilty of crimes and lead them to salvation (*Mokshanirvâna*) by the same way that the other Buddhas followed!"

Observe that the term for[5] *salvation* is not in Sogdian, but in Sanskrit. This is because religious terms are often untranslated, like *presbyter, bishop, church,* and other Greek Testament words which have become naturalized in the languages of Christendom.

The use of Sanskrit instead of Pali need not indicate a late date for the Sogdian version, for we are told by the Tibetans that the recension of the Hînayâna scriptures of the Sarvâstivâdin school was in Sanskrit. And a fragment of Vinaya found in Tokharish, a neighboring dialect, is in the Sarvâstivâdin form.

[5] *Journal Asiatique,* janvier-février, 1912, p. 184. Frequently repeated throughout the Jâtaka.

In spite of all the lost literature of the first and second centuries, we have enough fragments left that indicate Hindu and Parthian[6] literary influence.

The magical books of Scythianus, the Parthian Book of Elkesai, the Hindu folk-tales in the Talmud aforesaid, and other obscurer traces collected in the Historical Introduction to *Buddhist and Christian Gospels*, are enough to satisfy any philosopher who understands how to take account of the unknown.[7]

ALBERT J. EDMUNDS.

PHILADELPHIA, PA.

[6] In the Parthian Empire Buddhism was mixed with Mazdeism.

[7] See Darwin's "Imperfection of the Record," in his *Origin of Species*, with my remarks thereon in *Buddhist Texts in John*. In the latter also is a complete list of the sculptured scenes at Anurâdhapura.

THE HIGH COMEDY OF PHILOSOPHY.

There can be no vision without laughter.

SOME time ago I was discussing before a university class the different phases of philosophy, and not unnaturally the discussion involved many of the various definitions of philosophy that have been, to speak geologically, deposited through the ages. The number was appalling. Although it is not difficult to show a certain underlying agreement among them all, it still remains that there have been about as many definitions as philosophers. Indeed many a philosopher has indulged himself and puzzled the world with more than one, for, like many other things, philosophy changes in meaning with changes of standpoint or mood. But, as definition after definition passed before the view, the situation finally struck me as very amusing, and the cause for amusement was not merely the large number—which, I hasten to say, I did not try to exhaust—nor the great and amazing variety, ranging all the way from "a disease," albeit a "sacred" one, to "perfect wisdom" or "the science of the sciences," and from "the highest music" or "imitation of deity" or "meditation on death" to "the science that equates entity with nonentity and nonentity with entity," but also the unbridled extravagance, not to say the splendid absurdity, the superlativism of nearly every one.

"What a comedy this all is!" I found myself exclaiming inwardly and on the impulse of the moment I boldly added

to all the other definitions one more, as follows: "Philosophy is the highest comedy." So, doubtless, many of the other definitions came to be and so in one more way had philosophy made claim to a superlative! But—this bit of personal biography is nearly at an end—having fallen into that new definition of philosophy I was obviously under the necessity of either getting out of it, for it might prove a very deep hole indeed, or of explaining what I meant and proving the right of it even to the point of transforming what looked like a deep hole into a mountain-top with a fine view. So, not without some confidence, I set to work and in the end I convinced myself, if not others, that whatever truth or value might belong to other definitions no one could ever understand philosophy who failed to feel the comedy of it or be himself a philosopher who had no sense of humor. There could indeed be no real vision without laughter.

Of course philosophy is very commonly laughed at. Aristophanes set an example some years ago and in this matter instruction either by example or precept, however stimulating, has never been really needed. The philosopher has been the butt of much laughter, both open and with its head in the sand, ever since he began to make a spectacle of himself by philosophizing. He has made sport for others generally, not merely for the unphilosophical—are there any such?—readers of this essay. But *why* has he been laughed at? Any philosophical reader excepted as a matter of course, *because* in so many ways and with so much calm assurance he allows himself to be amazingly absurd and *because*, as I have to add, only suggesting how his disease may be not wholly without sanctity, he does appear even in his folly to see something not wholly unreal and to say something not wholly untrue.

Does any one ask me, out of his wonder and innocence, in what ways philosophy is absurd? Let some of the popu-

lar accounts of philosophy that seem not to have come to his notice give reply. However trite they will afford a very good introduction to my apology for the new definition. Thus here is one account.

Philosophy answers two questions in its own inimitable way. What is matter? Never mind! And mind? No matter!

Again, while art is all *eye* and religion is all *aye*, philosophy is also all *I*.

Then philosophy is anything that no one understands or in its arguments—it is always arguing—it is the gathering together in the name of truth of two or more not one of whom ever knows what he himself or any other is talking about. Philosophy is not art, not law, not science, not common sense, not religion, not anything in fact that any normal man cares about; and being so exclusive of all the ornaments or utilities or inspirations of life it is—here comes what is at least next to being its worst absurdity—ludicrously, unless after all I should say superbly, impractical.

Impractical philosophy is in any case; and this, although, reading such a wise interpreter of things human as George Meredith, we learn—is here possibly only one more jibe, carefully concealed, at the philosopher?—that, as the feet are necessary to dancing, so is philosophy to all living.

What can Meredith have meant? Whatever he meant, appreciation or ridicule, in view of the popular regard of philosophy it would hardly be extravagant to picture some specially bold philosopher, as metaphysical and ontological and epistemological and cosmological and even theological as bold, starring on some stage—I will not try to describe its scenery beyond suggesting that on the basis of a five-act play the home, the market-place, the state-house, the laboratory and the parish-house or church might very prop-

erly be represented—and on the other side of the footlights in all their evening regalia the performing philosopher's fellow townsmen or fellow countrymen and their families—successful merchants, great statesmen, distinguished scientists, reverent priests and in the upper regions the lower classes. What a merry time that audience would have and are we now having with them!

And philosophy, whether wise enough to laugh itself or not (for the moment I waive the possibility) is laughable. Its certain unintelligibility—suggesting the fool; its violence to ordinary words of standard meanings—suggesting Mrs. Malaprop or some cousin of that estimable lady; its extravagance of contradiction or paradox—suggesting the would-be popular politician; its habitual importunity amounting often to impertinence—suggesting the book-agent who forces on one something one does not want and, wanting or not, can not afford; and, figuratively when not literally, its lack of decent covering—suggesting discovered and discomfited privacy; all these things only show how laughable, how truly and seriously laughable, philosophy is. And yet—although modesty would forbid me to say this if present company were not always excepted or if the joke were not still very much on the philosophers—all the world loves not merely a lover but also whatever makes it laugh, I mean, makes it laugh really and seriously.

Philosophy the highest comedy! We are beginning to understand what that may signify, at least so far as it concerns those who look on. And what is comedy? No easy question. In trying to answer it, too, I dare not be philosophical. Philosophically I should have to say quite boldly: True comedy is real tragedy, tragedy at its limit, tragedy so sweetly coated as to be enjoyed, in short, tragedy quite out-tragedied. Or, again, employing the same forbidden subtlety: With respect now to its effect true comedy is laughter defying the tears that ought to flow or it is the

laughter of those who have wept until they laughed or are laughing having omitted or forgotten their more natural weeping. Or, just once more, in another vein but still philosophically: True comedy is a synthetic manifestation, under conditions of subjective surprise or unpreparedness, of incongruous elements of life or thought.

Such comic, if not also tragic accounts of comedy aside, however, we all know—observe often not without sorrow—that even a pun has its humor, its comic elements, and for this reason; that although on very superficial ground, in a word on merely verbal similarities, nevertheless it brings together as in a flash objects or ideas that are strange to each other. The meeting of extremes, as when the long and the short of it dance together—excuse the reminder of Meredith again—is the greatest joke of the day, of any day; nay—is there a door handy for my escape? —of eternity itself!

Puns at least, then, make extremes meet and, although their comedy must always or almost always be very light or, to offer a luminous if not lurid illustration, very *puny*—that one is weak enough to act, too, as a homeopathic cure,—nevertheless they fill the bill as to certain essentials. Vaudeville performances are perhaps an attenuation better. Their "syntheses of the incongruous" are certainly sudden enough and the incongruity is obvious enough, but! In truth there is a very large *but*. Even like puns, the vaudeville comedies are all too accidental or too superficial. They rest on no comprehension, no insight, no real depth and breadth of actual human life. The pun is only verbally deep. The vaudeville performance is silly, being only accidentally deep. Yet in both we find the ingredients, however poorly measured and mixed,—excuse the intemperance of my figure—of a potion that will make all who drink laugh. Measure them and mix them aright and the results will be alarming as well as philosophical. Always

the great need is more insight; the discovery, I suppose among other things, of the real tragedy that any comic situation, any meeting of extremes, must always hold. Real comedy, true comedy, the comedy that awakens, not hollow, empty, idle, foolish, but real, honest, serious, human laughter, demands insight; and, merely showing how magnificently the two work together, insight, real, honest, free, human insight has never failed to make laughter; not loud guffawing, not silly grinning, not loose joshing or jeering, but laughter. Very real laughter is sometimes so hearty and so—I mean but will not say—so profound that it never, or at least only very rarely, gets beyond the eyes. Such laughter were even spoiled if heard; a notion that quite accords with the statement of one authority—only I do not remember either his name or his exact words—that the best laughter is that which looks rather than sounds, the laughter, in short, of those who laugh to themselves. But, suppressing now even our own smiles, whatever other excesses we may deny ourselves, we must never again take comedy that has no stick of insight well mixed and generously mixed in it.

And now, besides knowing what comedy is, we are beginning to understand how philosophy is comic or even how it may be the highest comedy. Its insight, if insight it ever have, must be what makes it always comedy and, because with its insight go all those other things, unintelligibility, paradox, impracticability and the rest, the itinerary of this essay, now obliged to cease its rambling, is well laid out.

Quite seriously we have to consider the real humor of insight and of each of its numerous distinguished attendants. This humor, I foresee, as we catch it and come to feel it intelligently will account not more for the amusement of those who laugh at philosophy under such provocation as has been shown already than for a natural and

necessary humor of philosophy itself. In other words, from this point on the philosopher may laugh with us, and, although we shall not allow him to say that he who laughs last laughs best, we may have to admit that the order of one's laughter has something to do with its quality. In passing, furthermore, I would now go so far as to say—showing how my definition has grown on me—that only such philosophy can be true as, in the first place, makes other people laugh and, in the second place, has brought to its propounder a laughter which, however controlled and merely ocular, is at least as hearty and as human as that of any of his fellows. The pragmatist's test, requiring that what is true be that which "works" or "goes," can not hold a candle to this test of provoked merriment.

With regard, then, to the natural humor of insight, of philosophical insight, it must be assumed of course that the philosopher really does see something; that is, to be quite specific, that such well accredited philosophers as Parmenides, Socrates, Plato, Democritus, Plotinus, Aquinas, Spinoza, Hume, Kant and Hegel—I dare not come down any farther, although even in the last century, I feel sure, Mark Twain and Nietzsche were not the only humorists—really had some vision. Making such an assumption we can quickly catch the humor, or the comedy, of insight, for even with little knowledge of history we know that the philosopher has always seen what others have not seen. Sometimes others have said they saw it when they really did not or, perhaps with more truth, that they knew there was something there although they or their eyes, even their mind's eyes, quite failed to discover it, but in either case there is cause for amusement.

When one man stares with enraptured gaze at what other men can not even see, it is high time that somebody smiled, since incongruous things are met together, and the fun is only enhanced by the fact that the seer in the case

would suffer no serious check upon his vision did he tightly shut his own eyes. A blind philosopher, too, has never been as blind as others without the use of their eyes. To adopt a saying from Heraclitus, who, while known as "the weeping philosopher," was not without his merry jests: "Men in their folly are like the blind. Of them does the proverb bear witness that they are absent when present. Having eyes men see not and lacking eyes they see." And Heraclitus himself did not need his eyes to see what he finally saw. So what a veritable nest of jokes! No wonder that a man with so much humor unbent at times and even through his weeping indulged himself in a very little pun, albeit Hellenic: "The bow (*biós*) is called life (*bíos*), but its work is death."

The rich humor of insight is more than a matter of one man seeing without eyes and others not seeing with them. What the insight reveals has this very humorous quality: It is so commonplace as not to have been noticed and so unnoticed as to seem upon discovery almost if not quite wonderful and even miraculous. The very essence of insight is discovery, not of anything outside of life or nature, but of what dwells quite within life or nature, not of what something outside is, but of what this life or this nature really is. So for insight are the always seen and the not seen, the familiar and the novel, the commonplace and the wonderful met together, and could anything be more laughable?

We all laugh at the man who, wearing his glasses, looks for them and he himself, his search at last over, laughs too, but the investigations and discoveries of philosophy are quite similar:

"I would know how I know;"

"I live and I would live as I ought to live;"

"That which I am I will to be;"

"I will that not my will but the will of God or of my

own real self or of what is true and good and beautiful be done;"

"The world really is, not what everybody finds it, but what I think or make it."

Such things and many others like them, very humorous things I submit, transforming as they do the commonplace into the important, the already real into the ideal or yet to be realized,—such truly funny things the philosopher is saying in so many words all the time. They are very essential parts of his stock in trade.

Philosophy in respect to what it sees and says is so different from science. Science deals with what can be isolated and so with what can be studied objectively, methodically, exactly, and described quite logically and soberly, but philosophy with what can not be isolated, that is, set off and out by itself, and so with what is never special or local but is instead universal. Thus science depends on limitation of the field but philosophy would be helpless were the field limited. Science would see what can be seen as this or that here or there and now or then, but philosophy would even see the seeing or be the being for which there can be no such boundaries. The isolable and formally describable or explainable, insists philosophy, can not be the vital; the manifest object of experience can not be either the real experience or the real thing experienced; for vitality or reality are wholes, not prosaically isolable and definable parts.

Dealing, then, with what is too vital to be isolated, too commonplace or too natural and essential to be nicely measured or upon discovery to be in any way regarded soberly, and I may add, too general to be apprehended as the things of space and time are apprehended, philosophy is bound to a peculiar task.

While science can be and must be sober, philosophy can not be and must not be so. To use a flippant phrase

in a very serious way, philosophy is constrained to be intemperate to the point of "seeing things." Imagination instead of direct observation, speculation instead of "eminently respectable" reasoning, poetic thinking instead of prosaic thinking are its proper, however unconventional, methods. Simply it has no choice but to look as best it can and with what saving sense of humor it can and with due sense of the amusing figure it is bound to cut before all respectable citizens, at what is commonly quite invisible. Only a quasi-vision is thus possible to philosophy and its speculations, but how the philosophers have looked at what they have seen so fictitiously!

Just to illustrate how the philosophers "see things": There was once a man, of whom the reader knows and at whom he may laugh or smile as affectionately as he pleases, who lived in a world of things-in-general and had all the relations of his life to these. Would you appreciate his unusual plight? Then think how it would be, how strange, if not how hair-raising, to catch sight of a tree-in-general out there on my lawn—which would in fact have to be a lawn-in-general—with birds-in-general singing songs-in-general from the branches-in-general and, while listening-in-general to the peculiar beauty-in-general of that generic music, to be disturbed by the bark-in-general of some passing dog-in-general. Think of that, I say, and then reflect that Plato, among others, had some such experience—philosophically and to-the-gayety-of-nations-ly.

Plainly philosophical vision calls for humor. Its rapturous gaze at the invisible, its startling discovery of the commonplace and its universal view, its quasi sight of the whole or the general, are all most laughable; so laughable indeed that it is a relief to know how much the philosophers have laughed themselves. The gloomy Heraclitus, as we have seen, was a rich humorist. Socrates had his irony. The dialogues of Plato were loaded with merriment—al-

though not always as choice as might be wished, as when the arguing sophist Thrasymachus is answered with the reminder that he really needs to wipe his nose. And vision, as I keep repeating, has always brought laughter. Seeing beyond accepted forms and standards it has always brought the freedom from these, the license, the unbending, of which laughter is such an excellent expression. But vision, or insight, was said to have a train of attendants, its court-fools, and some of these, to which we may now turn, have been, and still are, inimitable jesters.

Probably I do not need to speak again, certainly not at any length, of unintelligibility. I would only assure you that it is the business, if not quite the conscious duty, of philosophy to be at least reasonably unintelligible. What I mean by "reasonably" any good lawyer may decide, being so much more competent to do so than I. But, as to the unintelligibility, to all that has been said I merely add that what men commonly understand or can understand is relative to prevailing views and tests, whereas philosophy and its vision can count for nothing if they do not imply something radically different from what prevails. So true is this that vision being still shadowed by the old standards is always greatly puzzled itself, having quite as much the character of a *what* as of a *that*.

"Yet my vision," interrupts the philosopher, "although puzzling to me and unintelligible to others, although very irregular, informal, unconventional and alien, is not without supreme meaning. Far better is it to be right and unintelligible than under the law! And even death itself were better than that I should betray my vision!"

Not so heavily serious, Mr. Philosopher, if you please. Your usual heroics are not needed here, for we are now readily sympathetic and at the moment are so affable that we would even prefer you to be unintelligible, enjoying you—such is our present happy mood—much more and ap-

preciating you more, too, in that rôle; that is, if you will be at least reasonably unintelligible!

Closely connected with philosophy's unintelligibility, which might be said to vary directly with its insight, there is a much remarked and much criticized violence to names. "Why not speak the king's English?" says some real man to some—let no unphilosophical person put it in this way—fool philosopher; "Or," going on, "if you must think so differently from real men, why don't you invent a language of your own?"

Good questions these and quite answerable according to their own folly, but I will meet them as soberly as I can. Replying to both at once I say simply that the vital service of philosophy, as necessary to life, you remember, as feet to dancing, must always depend on its strange and even shocking use of familiar words, on different meanings for standard terms.

A certain reader of a certain philosophical essay, that searched matters rather more deeply and freely even than is usual, had no comment to make but this: "What offensive profanity!" and in a sense, insight must always be profane, using many precious words in a shocking way. Small wonder that an unusually intelligent classifier in the library at the University of Michigan shelved a certain book, *A Cursory History of Swearing*, with the *other* histories of philosophy!

But there is profanity and there is profanity, just as there is lawlessness—that of destruction—and lawlessness —that of reform. What really is life or anything connected with life? Such is the philosophical question, and the answer, however profane, must come: "No longer that, however sacred, but this!" The old word must remain too; else there were no point and no challenge. Life—not something Sanskrit or Hottentot—life in good, unhesitating king's English is this startling thing now newly revealed.

Of course men never dreamed of any such marvelous meaning for the term; of course its new use shocks them terribly; but so much more reason that they should be made to look to their speech, not to say to the thought back of it.

Where, however, is the humor? The humor of old names for new things may be seen in the following tale from Mark Twain's *Adam's Diary*. In the Diary, as you know, Mark recounts how Adam and Eve went about the Garden naming the wonders thereof, the strange animals and the rest. They came at last upon a galli-wasp. What should they call it? Adam, usually quick with fitting names, was hopelessly puzzled, but Eve, her woman's intuition no doubt serving her now in good stead, exclaimed: "Adam, let's call it a galli-wasp." "But, Eve," cries Adam, "why call it a galli-wasp?" "Because," came the woman's answer, "because it really looks so much like one." Eve had the vision which naming strange things always requires. The story is known to all and, perhaps too obviously, I have told it in my own way, but it will indicate very well the pleasant comedy of all naming. Also it has had for me its analogies in many of the discoveries of philosophy. Thus, here is one, as significant and humorous as any of the others.

There was once a Greek, Anaxagoras, who was, so we are told, the first to call something he found in the walks of life by the name of mind = *nous*. The thing so called had been in the lives and experiences of his predecessors for years and the word, the name, was a standard word in the language, having been in good usage nobody knows how long. Anaxagoras, however, was the first to apply the name to the thing. And why? Again Eve's reason. Perhaps Anaxagoras had a wife of his own and her woman's intuition to help him out. Of that we can only guess. In any case the reason was unhesitatingly this: Because the thing discovered looked so very much like mind.

But, once more: "This is what life is," exclaimed the hero in our last novel, "I never knew before what it was nor how great it was." "Why?" you might have asked him, and answering he must have joined the chorus of all discoverers: "Because it looks so like the old old thing!"

In a final sum then, the new strange thing that is like some old thing is as near to being the philosopher's stone as any thing I know and if I may hold the figure, it is a stone that owes no small part of its mystic color and luster to the humor of the new naming or of the strange likeness that must always attach to it.

But naming the new things in the walks of life is probably the very simplest way in which philosophy at once shocks and amuses people when it tries to express what it has discovered. Unintelligible as it often is because of its violence to terms, it is made doubly unintelligible by its readiness to utter its wisdom in paradoxes. For the life of insight the descent to paradox is easy.

What really is this thing? Life? The world? God? Self? What is it *really*? The question itself shows that strangers are already standing at the door of one's tent, and the strangers must be met. Yet how? The thing inquired about must be hospitable; it must identify itself with what it has never been, receiving the strangers at least as possible angels. But such hospitality means paradox, the bringing together of things opposed. Strangers start inquiry; inquiry makes thought; thought would entertain the strangers; and the result, in fact if not always in form, is paradox.

Every name, newly applied, always hides a paradox, but all the paradoxes of thought and its discoveries are not hidden. The Greek thought and in the end made the discovery that he himself also was a barbarian. The Jew found himself also a Gentile. Christian meekness, as has often been said, has had some of its best expressions in the

lives of Jews. And in general in the relations of men and in the relations of things thought has had a way of reversing normal conditions. Indeed at least at one stage in its activity paradox has always seemed the only adequate and candid way of expressing what has been seen.

So man was found to be non-human, at least to the point of being a monkey, a quondam monkey; and I do not need to multiply the cases of thought's paradoxical transformations. The thinker can no more avoid paradoxes than a statesman can avoid inconsistency.

Of course the paradox is irregular; it does not belong in well-ordered society and conversation; it violates logical conventions horribly; it is perhaps the philosopher's most striking way of staring into the dark, of looking, as if entranced, at what others can not see; but it is as indispensable to thought, which must be constantly outgrowing its forms and which finds nothing more thoroughly informal than paradox, as—what shall I say?—as life and death are to growth.

That comparison is also a good illustration. See beneath the surface of things and life and death, as also cold and hot, lawfulness and lawlessness, good and evil, divine and human, infinite and finite, become definable in terms of each other. Thought, in short, never fails to make the very strangest bed-fellows.

So, again, the comedy of philosophy is presented to us. If up and down, order and disorder, man and monkey, light and darkness, good and evil, life and death are the same, this world is indeed a stage and the performance—I do not need to advertise it as continuous—is dangerously near to being—what is the phrase?—a side-splitting farce. Only, the issues are serious and, laugh as we must, we always feel, all the more for our laughing, that a vital truth lies hidden in those strange ways or those strange words of men.

In professional philosophy, at least for its ordinary history, the comedy of philosophical paradox began when Anaximander crossed the stage and said in so many words: "All things are nothing"; a declaration that may well suggest the hospitable invitation to dinner *any* evening, obviously equivalent to no real invitation, and Heraclitus continued the performance with all sorts of mystic announcements about good and evil being the same, justice depending on injustice, immortals being mortal and mortals being immortal, and so on almost *ad infinitum* and quite *ad immoderatum risum*. Then came Anaxagoras with his elements or cosmic parts so side-splittingly wonderful as each by being infinitesimally small to contain the whole cosmos and soon after Anaxagoras arrived Socrates whose supreme wisdom lay, as he amused himself much and others some by saying, in his knowing that he knew nothing.

Aristotle, strangely enough, was not a paradoxist, but he relieved the play by being delightfully direct and flat. Quite parenthetically may I speak of him? Flatness, so different from paradox, is after all only another medium for the expression of insight and so another way of not being understood. Thus how profoundly wise it was of Aristotle to assure his fellow men that the way to learn to do anything was to go ahead and do it, that sight or vision was the subtle process by which man apprehends the visible, and generally that as man is able in any way the world about him is correspondingly possible. I have sometimes thought that the following lines by Ben King might have been dedicated very appropriately to Aristotle:

"Nothing to do but work,
Nothing to eat but food,
Nothing to wear but clothes
To keep one from going nude.

"Nothing to breathe but air—
Quick as a flash 'tis gone.

Nowhere to fall but off,
Nowhere to stand but on.

"Nothing to comb but hair,
Nowhere to sleep but in bed,
Nothing to weep but tears,
Nothing to bury but dead.

"Nothing to sing but songs,
Ah well, alas, alack,
Nowhere to go but out,
Nowhere to come but back.

"Nothing to see but sights,
Nothing to quench but thirst,
Nothing to have but what we've got,
Thus through life we are cursed.

"Nothing to strike but against,
Everything moves that goes,
Nothing at all but common sense
Can ever withstand these woes."

But Aristotle in his day could be flat and wise at the same time, for he was free from the peculiar restraints of form and tradition that had forced the vision of his predecessors to express itself paradoxically. Still, if only for their contrast, the Aristotelian tautologies and platitudes have a humorous quality all their own.

Leaving Aristotle, however, the comedy of philosophy of course did not close with him, although I can hardly turn this essay into a comedian's history of philosophy. St. Augustine was a good deal of a humorist. So was Aquinas. So, too, was Spinoza with his one God, or substance, his infinite attributes of that substance, his infinite modes of each attribute and his infinite finite modes of each infinite mode, for there is a point beyond which even infinity is best met with a good laugh. As to Spinoza, too, I am sure that his own humor, quiet as it was and obviously had to be, saved him under conditions that must have robbed most men of all balance of either thought or feeling.

Then there was Kant, but his *Critique of Pure Reason* must speak for itself; and Hegel's humor is known to everybody. Certainly Hegel has saved philosophy from losing sight of the merry paradox for many a day. The thing that was not at once its own negative or other had no interest whatever for Hegel, as forsooth it should have no interest whatever for you or me. We sometimes say of a man that he is one who will not stop at anything, meaning so to reproach him, but according to Hegel there is nothing that anybody ought to stop at. So there you are and being there you are doubtless wondering also, as you promptly should, where—how shall I put it without profanity?—under the sun you are.

But the case is now quite clear. Philosophy is a comedy, even the highest comedy; thanks to its paradoxes but not without some gratitude also to its platitudes and to some other things, general or particular, to its eyeless vision, and its profane speech and its foolish—or wise?—unintelligibility. I have yet to speak of its impractial nature. Still, why should we spend time on that? Philosophy, remember, is as necessary to life as feet to dancing, and dancing is what one practices, not feet. Philosophy always impractical? Of course! What else would you have? And the philosopher's salvation is the laughter for which he is so ready whenever he really sees things and with the comfort and support of which he can do anything that *is* practical—even rendering unto Cæsar that which is Cæsar's. The compromises which practice must ever force upon vision are no longer compromises but ideal working measures, when they are taken with proper humor.

With needless modesty, doubtless, I have said nothing of the philosopher's lack of clothes: nor was I going to say anything. The lack is so obvious and others might be embarrassed, even if the philosopher should not be, to have such a matter discussed. Mention ought to suffice.

if even mention be not too much. But the trouble is that the philosopher exposes other people no less than himself. Of course the nude in art has interested many—for its sensuality—for its purity—and the nude in science has also had its students who have commonly known it by another name, the natural, the objective, the physically or materially true and real. But the nude in philosophy—the exposure that philosophy makes, or at least thinks to make, of all that lies beneath the outward appearances of men's lives, making those appearances at most only the most gauzy draperies—is certainly not less likely to catch and hold the gaze of curious mankind, looking as men always will at the sordid and material, at the heroic and spiritual, whenever and wherever exposed.

Still, if I keep on, I shall have everybody blushing for his disclosed smallness or for his uncovered greatness and tears instead of the intended laughter may spoil my comedy just as it is about to draw to *such* a successful close. I have wished only to make evident the humorous discomfiture of exposure for people that have been thinking their inner motives and ideals, their hopes and their loves, their fears and their hates, at least decently clothed. What a jest, I mean what a fabric of gauze, any institution is!

And at the court of philosophy—did I forget to say, of course with Plato, that the philosopher is the only natural king?—there are others beside those mature jesters whom we have been hearing. Thus there is a swarm of youthful and mischievous pages. The philosopher's formula, for example, that means everything, the whole universe in fact, yet really is applicable to absolutely nothing. And—is it safe to let this fellow in?—the philosopher's pecuniary wage, which he gets for wisdom that is so unconventional as to be quite without price. But here embarrassment, if not resentment, overcomes me and I refuse

to go on, exposing the philosopher to another of these rogues!

Philosophy *is* comedy, the highest comedy; and I can brook no rival for philosophy in this distinction, save possibly one. Should somebody insist that religion showed a still deeper humor, that the God who made the rain, for good or for ill, fall alike on the just and on the unjust or always, not merely on Calvary, brought reformer and malefactor to the same death just as earlier he had brought them into the same life of violence to the law, must be the supreme humorist and should therefore never be worshiped without the possibility of a smile on the face of his worshipers nor pictured without a smile at least in his all-wise eyes, in all probability I should make no protest. Religion is the divine comedy.

But surely, insists some one before I can get away, surely philosophy is not merely comedy. Of course not. Nor is comedy. The meeting of things incongruous always brings tragedy too. Have you already forgotten those definitions of comedy that I "dared not give"? In the history of national literatures tragedies and comedies very properly have arisen together—at such time, be it remarked, as when little man has run up against big nature and has succeeded in showing how much bigger than nature he really was!—and have reached their extremes *pari passu*. But through the pages of this essay—why must I still have to tell you that it is time to laugh?—I have simply chosen to laugh with philosophy and have asked you to join in the merriment. Some day I may boldly invite your tears on the same evidence, but not now. Enough now that there can be no vision without laughter.

ALFRED H. LLOYD.

UNIVERSITY OF MICHIGAN.

THE MONISM OF THE GERMAN MONISTIC LEAGUE.[1]

IT has been the prerogative of ancient and modern philosophers and theorists to delve into the mysteries, the first cause, origin and purpose of all things, phenomena visible and invisible. What is the result? A never ending chain of arbitrary terminologies, an endless war of pen and sword, a bitter strife between science and religion stubbornly persisted in by powerful, good, brave and illustrious men of both parties, and claimed by both. The consequence is that hitherto we have not been able to answer definitely questions like the following: "What do we know of the origin and nature of things?" "Which laws determine the course of nature, the origin and end of life?" Whatever physics, chemistry, astronomy and other sciences have accomplished in explaining these and similar queries, a point is finally reached where human understanding, reasoning and research work prove deficient. Thus, toward the end of his life, Du Bois-Reymond summed up his life-work of indefatigable research work in these few modest words: "We know nothing about a beginning, first cause and end of all things, and we never will find out."

At any rate, the attempts made by ancient philosophers, especially those of India, Arabia, Egypt, Greece and Rome,

[1] This article consists mainly of translations from authentic sources dealing with the subject. In order to adapt the teachings contained in the Catechism to American conditions whole sections have been eliminated and others modified. They differ from the belligerent attitude of the German *Monistenbund.*

to fathom the secrets of nature, have left remnants on the strength of which their modern successors have constructed new theories and hypotheses by extracting truth from nature itself, previous important observations and discoveries leading to new ones. Thus the way is being paved towards finding and determining nature's laws and bringing nature's forces into service for the benefit of humanity. This unremitting research work into the minutest as well as into the remotest parts of the universe is constantly confining the realm of the mysterious and inexplicable to more narrow limits and is paving the way for the spreading and better appreciation of monism.

Monism holds that there is but one form of reality, whether that be material or spiritual, whilst dualism attempts to explain facts by reference to two coexistent principles. But the aim of knowledge is explanation, and the dualism and pluralism which acquiesce in recognizing two or more distinct forms of reality have so far failed of explanation, and modern monism in all its forms is forging to the front, launched and upheld by some of the foremost men of to-day.

Monism, as first expounded by Plotinus (204-270 A. D.) one of the most important representatives of neo-Platonism, ignores personal individuality and volition and merges all finite existence in the featureless unity of the absolute. Thus the protest against the old form of monism was started. Turning to the historical forms of the theory, Plotinus may thus be classed as a mystical monist, whereas Spinoza (1632-1677) may be called a materialistic monist with an inconsistent touch of mysticism and a certain concession, more apparent than real, to the spiritual side of experience. Hegel (1770-1831) is an intellectualistic monist, explaining matter, sensation, personal individuality and will as forms of thought. The doctrine of Schopenhauer (1788-1860) and Eduard von Hartmann (1842-

1906) is a monism of cosmic will which submerges the individual as completely as Hegelianism, though in a different manner.

The latest form of monism, founded by Ernst Haeckel (born 1834) is based on the results obtained and discoveries made by modern scientists and philosophers, men like Copernicus, Kepler, Newton, Goethe, Kant, Laplace, Darwin, himself and a host of others. It stands by the conviction that the correct philosophic attitude is to accept at least provisionally the main distinctions of common sense, thus opening the avenues leading to the monistic conception of the universe to all who wish to gain an insight into the modern discoveries and views relating to the "world-machine" as Carl Snyder put it.

On this basis, the Monistic League (*Monistenbund*) of Germany was formed in January 1906, and since then branches have been established in many cities of Germany, Austria, Switzerland and Holland. Periodicals like *Das monistische Jahrhundert* have been created, great meetings were held in the largest halls of Berlin and heated public discussions were the immediate result. The orthodox churches and conservative classes became so alarmed at the threatening aspect and dimensions of the new movement that they forthwith organized an opposing body named *Keplerbund* (Kepler League) for the great astronomer. The latter society is composed of the more conservative scientists and theologians, and its immediate object was to attack Professor Haeckel's scientific reputation and standing, to undermine and counteract as far as they could his influence over his followers at home and abroad.

President-Emeritus Eliot's pronouncement on the "religion of the future," which he says will be a monistic religion, is only one of the signs of the times, showing the irresistible tendency in modern thought and life toward a monistic conception of the constitution of the universe.

a monistic philosophy or religion. All this is the inevitable and natural outcome of the rapid and revolutionary progress of modern science and philosophy. Dualism and pluralism are decaying at the very roots. A monistic, a more scientific, conception of things constituting the universe, is rapidly taking the place of the old orthodox dualistic notion. Modern science and philosophy are revealing the world to us as a spiritual commonwealth, self-existing, self-governing and self-directed.

At the beginning the German movement laid the greatest emphasis on the religious and purely theological aspect of monism as an anti-dualistic theory of the relation of God to the world or of spirit to matter. Within recent years, however, it has paid attention to ethical and social aspects, to individual and social life. Thus the new, complete and thorough-going monism proclaims man to be merely the most highly individualized form of the spirituality of the world. The German League has been organized to further the evolutionary theory of the world and to resist reaction in church and school, state and society. Thus its mission is to purge and purify man's views of life of every superstition and hypocrisy; to elevate man's conception of himself to the plane of a true and natural dignity, to arouse an enthusiasm of humanity, to give man an insight into the world as a vast, living, striving, conscious organism, of which he is an integral part, realizing the "kingdom of heaven" during our life on earth.

The Munich (Bavaria) branch of the League celebrated the sixth anniversary of its foundation in the summer of 1912, and in announcing the celebration it proclaimed the following guiding principles:

"The monist is thoroughly imbued with modern ways of thinking, by ignoring the existence of a supernatural being and force creating and governing the universe and all its parts. He strives to understand this from natural

causes as taught and explained by contemporary sciences. Rejecting all beliefs in ghosts and miracles, he is convinced that all that happens in this world and all that ever did and will happen, is, was and will be the result of natural causes; he is convinced that whatever phenomena cannot now be explained satisfactorily will be at some future time as the result of untiring experiments and researches made by scientists, specialists, economists in the fields of nature and the science and conduct of life. According to this view the monist arranges his individual and communal life according to reason, existing conditions and laws.

"To a monist, education culminates in exercising and fulfilling duties toward himself and his environment, including not only his immediate family, community, state and nation, but also the generation to come (eugenics), thus replacing the prospect of a reward in the future, held out and preached to the credulous millions. Thus the monist's ideals of life's activities grow out of and culminate in his conception of conditions viewed with a spirit of fairness and without prejudice.

"The monist's very insight into the natural connection of cause and effect arouses in him that intense feeling of responsibility toward ameliorating and elevating mankind that creates in him the continuous desire to improve and enlarge his views, inspiring him to an unceasing endeavor toward refinement and perfection.

"Keeping his mind free from fanaticism and dogmatism, the monist defends his scientific mode of thinking against the traditional representation; he stands for unconditional freedom in matters of belief, at the same time respecting the personal conviction of others, hoping that in the end not the current creed or faith, but the correct way of doing things will determine man's worth in society in this age of progress.

"Monism is not a creed, religion or system fixed by

dogma, but it is simply an intellectual movement growing out of man's desire to base life's aspect and the conduct of life on the grand achievements in modern science and to live the life of a man actuated by common sense and imbued with obligations toward his fellow men.

"Being based on the experience gained by a thorough comprehension of nature, especially the laws of energy and the course of evolution, scientific monism is gradually replacing the traditional dualism which separates the unseen from the visible world, nature from mind, soul from body.

"Monism rejects that prevalent mode of dualistic thinking which finally arrives at and adheres to traditional conceptions of faith and supernatural interferences in nature's workshop.

"Monism regards *man* as a product of natural development, as an organism evolved from primitive sources through his own inherent powers, aided by his surroundings, and able to fit himself for continuous improvement by observing the rules for the conduct of life.

"Monism defines the soul as the sum total of all mental and intellectual functions of an organism or a union of organisms. In conformity with established psychology it does not consider the soul separable from the body and for that reason rejects its immortality. Furthermore if we substitute the word 'character' for soul, the definition given the latter may also be applied to the former. With the death or annihilation of the individual organism these properties or attributes simply cease to exert themselves, just like any other quality or trait that characterized or gave life to the individual.

"Monism regards the various religions and creeds as a product of the modes of conceiving or trying to understand and interpret nature, visible and invisible, a mental process that influences and characterizes different people at different times and places under unlike conditions. At

the same time, monism tolerates and recognizes the value of religion and the importance it exercises in educating the young and ennobling mankind, but does not endorse the ultra-natural beliefs forced on the minds of the faithful by men of undoubted sincerity, high attainments and zeal.

"Monism does not pretend to remove all doubts, nor to be able to solve all the riddles of life, but it represents a view of life based on the achievements of research work and discoveries in astronomy, geology, anthropology, biology, chemistry and allied sciences, thus preparing mankind for a new era of intellectual and moral progress and enabling intelligent men and women of all classes to think and to act for the welfare of all.

"In trying to apply monism to practical life, we may ask: How does the monist regulate his private and public mode of living? To this monism replies: Regulate your life so that the prosperity of the community and of mankind is assured by keeping the individual in a healthy and vigorous condition, at the same time looking toward a thorough adaptation to surroundings and to the propagation of healthy offspring. Let there be no standstill, no matter how well you have developed, but strive forward toward progress, renewed activity and constant productiveness. Persuade every accessible individual to apply these rules of life, and monism is destined to reach the greatest number of individuals, saving them from degeneration, and to reclaim those that are not living up to the precepts of nature and the community."

In Germany, the birthplace of the new monism, the "Monistic League" attempts to realize freedom of conscience guaranteed by the constitution, thus permitting every citizen to profess his opinion freely in all the states forming the empire. In conformity therewith, the League tends to replace in the schools the religious-moral educa-

tion by a *moral education* based on the results of discoveries and achievements of modern science and by teaching civics so that the future citizen may learn to interpret and exercise the laws as conditioned by and related to the surroundings, community, state and nation.

Thus the inventive mind of a German enthusiast, Dr. L. Frei, evolved a "Monistic Catechism," of which Professor Haeckel says: "I have read with keen interest the catechism teaching the monistic aspect of the world; it covers the ground well and is bound to gain universal approval and success."

A MONISTIC CATECHISM.

The Universe.

1. What is the universe or world?

To primitive people the earth upon which we live was and still is a microcosm, a world in miniature, with heaven stretched over it. According to the ancients the macrocosm, all universe, centered in the earth, around which moved not only sun, moon, and planets, but also all the other celestial bodies.

Thus the earth was considered the center of the universe, until Copernicus (1473-1543) and others defended and confirmed the theory that the earth, the moon and the other planets revolved around the sun, receiving also their light from this central body. Subsequently Kepler (1571-1630) discovered the laws governing the motions of the planets, Newton (1643-1727) calculated the mass, density and volume of celestial bodies.

Kirchhoff (1824-1887) and Bunsen (1811-1899) discovered and developed spectrum analysis, now called spectroscopy, by means of which the chemical constituents of celestial bodies can now be ascertained when comparing

their spectra with those of the various elements existing on our earth.

In short: Macrocosm, universe or world at large, includes all celestial bodies as well as all substance filling out the space between them.

2. How old is the world?

According to biblical belief, the world has been in existence about 6000 years, but natural science tells us through its silent but truthful and dependable witnesses that the world has neither beginning nor end. It has never been created, and all parts composing it will remain in some form or other as will be explained forthwith.

3. What laws govern the universe?

The untiring efforts of sages of antiquity and modern times have finally culminated in determining two laws governing the universe. The first one, discovered and framed by a Frenchman, Lavoisier (1743-1794) teaches the conservation of matter: "The sum of all that constitutes the universe remains the same in spite of all changes of form. Not a particle of matter is lost, wasted or added."

The second law, attributed to several men of science, but finally formulated in a definite form by Julius Robert Mayer (1814-1878) and Hermann Helmholtz (1821-1894) is the law of the conservation of energy: "The sum of all forces acting in and propelling the universe producing all phenomena remains the same." Heat may be changed into motion, the latter may be converted into light, sound or electricity; correct measurements show that the amount of energy apparently spent has remained, although represented in different form, and that no particle of force or energy in the universe is lost, wasted or added.

These two fundamental laws dominate not only the

inorganic, but also the whole of organic nature, the life of plants and animals as well as the existence of man.

4. What is the world governed by?

According to the previous chapters, it is evident that the world governs itself.

Science does not recognize (because it cannot locate) a being outside of the universe which governs the universe.

5. Has there ever been a beginning of the world?

According to the Bible and to similar books and traditions, among civilized and uncivilized people, the universe was called into existence by one or more supernatural beings. Yet some of the ancient philosophers with advanced ideas taught the birth of the earth from primary elements or forces, and even some of the new cosmogonies based on the theories laid down by Kant and Laplace cannot cut loose from a beginning of the world. But science teaches us that cosmic time and space are infinite. The world has had no beginning and will have no end. All matter has been and will be forever in constant motion and is subject to continuous changes. Thus new bodies are being formed by contraction, others disintegrate forming the basis for new organisms.

6. Therefore, are we justified in asking: What has the world been made of?

No, for according to incontestible truths arrived at as mentioned previously, nothing can be created from anything not existing in spite of all theories, dogmas, elusive explanations and elucidations invented and taught by otherwise learned theologians and Bible critics; the natural laws prevail, according to which the substance forming the universe never had a beginning and never will have an end.

7. Will there be an end of the world?

No. The energy of the world is constant. There will never be a maximum nor a minimum of energy, and when two atoms or two celestial bodies merge, heat is liberated and converted into a corresponding amount of energy. The universe, therefore, is the only *perpetuum mobile*.

8. How was the beginning of our earth?

Neither the earth nor the other parts of the vast universe were created, but the earth, as well as the other planets forming part of our solar system has separated from the sun, first becoming a nebulous ball, cooling off by and by, at the same time emitting heat, until a hard crust was formed. The steaming atmosphere surrounding the earth became lower and finally covered the surface with water, and organic life on earth became possible.

9. How did organic life come to earth?

Not through an act of creation, but it very likely evolved from inorganic matter forming albuminous, gelatinous, carbonaceous compounds that became animated and turned into organisms consisting of cells. This is called spontaneous generation by modern scientists and is going on all the time. There are, however, various theories trying to explain the origin of life on earth as transplanted from other celestial bodies, but they take us to still more remote ground, reverting to a chain of questions: "How did organic life originate *there*?"

10. Where do our plants and animals come from?

They have gradually developed from the one-cell organism. This truth has been finally established by the untiring researches of Lamarck, the Frenchman, and of Charles Darwin, the Englishman, who thus became the founders of

the modern theory of evolution, teaching that all organisms have been evolved from the next lower ones. Whilst the details of the whole process of evolution will forever be inaccessible to us, evidence gained from research work goes to prove that the theory of evolution comes nearer solving the riddle of organic life than any other theory, antiquated books of "wisdom" or traditions of mystic origin.

11. Is there an essential difference between organic and inorganic nature?

No. Natural science recognizes no dualistic, but only one monistic principle in nature, for the same law of substance that governs organic life is also the cause in the changes of inorganic bodies. A difference exists in characteristic chemical-physical properties, especially the ready decomposability of the albuminous and carbonaceous compounds which cause the phenomena of motion, distinguishing living organisms from inorganic bodies.

12. Is it necessary to attribute the processes of nature to supernatural causes?

No man of science nowadays will explain the phenomena of nature by taking refuge in a supernatural cause. Physical and chemical laws obtain in nature's workshop. Only a few scientists still cling to supernatural causes in explaining organic life; most of them respect the general laws dominating organic beings, as well as inorganic bodies. Thus, instead of asking to what end a body exists we try to find the laws governing its existence.

13. Are design and perfection dominant in nature?

Not at all. However, according to the theory of evolution as laid down by Darwin and his disciples, it became evident that a perfection of organisms is attained solely through self-activity of every single part, a principle called

teleological mechanism. But even after an organism has adjusted itself to conditions, its perfection would not be a permanent one, but subject to changes influenced by many conditions, such as environment. Daily observation in the animal and plant kingdom prove this imperfection by producing organs poorly developed, useless, rudimentary, and even dangerous to the propagation of its kind. According to this there will never be perfection in nature.

14. Is there a moral order of the universe?

Nothing but a negative answer may be gained through a perfect understanding of the preceding chapters. There being no room for a moral order in the physical and chemical constitution of the universe and in the history of the organic world existing for countless years, there are no other laws prevailing in the history of nations than the all-dominant precepts of nature. The struggle for existence is not fought out and decided by the moral order, but by the physical and intellectual excellence, activity and superiority of the individual.

15. Is there room left for a "Providence"?

With the elimination of a moral order established on uncertain ground and attributed to mythical personalities vanish all traces of a providence, which is but the fancy and creation of man who considers himself the center of this vast universe. However, one who understands nature thoroughly knows also that the life of the individual is dependent on mechanical causes and conditions.

Man.

16. How did man come into existence?

Man was not formed of clay and equipped with an immortal soul by a creator, but has developed gradually from

the vertebrate animals, lastly and very likely from the group of primates.

17. What position does man occupy in nature?

After it has been proved that our earth is not the center of the universe, but only a minute part of it, it has also been shown that man is not a godlike creature, separating him from the rest of the organic world, neither is he the predestined center and ultimate aim of all life on earth, but only a link in the chain of living organisms, no matter how eminently the superior development of his nervous system enables him to occupy a dominating position among the other organisms.

18. What has man in common with animals?

The animal body, as well as the human, consists of millions of little cells combining into a great variety of tissues and organs, all of which perform reciprocal functions. Like all quadrupeds he has four limbs, consisting of upper and lower arms, upper and lower legs, wrists and tarses, metacarpal and metatarsal bones, and bones of fingers and toes. Muscles and nerves, joints and ligaments are similarly constructed. Man is to be classed with the mammals on account of having mammary glands. He is covered with more or less hair. In short, all organs are built on the same principle in man as in animals. The main distinguishing features placing man nearer to the primates than to any other living animal form are the formation of hands and feet, consisting of five members each, all covered with nails, the position of the thumb, the uniformity of the four kinds of teeth, the simplicity of the pear-shaped uterus and the structure of the brain. Man's nearest progenitors among the apes are very likely the primates of the old world, both showing remarkable similarities of the structure of the bones as well as of the

organs of the body. Single bones discovered in the oldest diluvial stratum on the island of Java have been put together to construct a hypothetical *pithecanthropus erectus*, the nearest missing link between man and ape. Other links have been discovered, and are still being looked for, in other parts of the globe.

Occasional reports from the interior of dark continents about primitive people discovered show that missing links are continually in the making, but are hidden from view in inaccessible parts of the globe.

19. Is the embryological development of man different from that of other animals?

No, it is essentially the same. The fusion of the spermatozoon, the reproductive cell of the male, with the ovum, the corresponding cell of the female, develops one resultant uninucleated organism or cell which is called the zygote. This process of fusion between the two kinds of reproductive cells, which are called gametes, is called conjugation, fertilization of the ovum, and its result is the establishment of a new individual.

20. What does the physiology of man teach?

It teaches that man belongs to the great group of vertebrate animals, for in the first stages of development the human embryo is very similar to that of other vertebrates. It may be here noted that the great embryologist Karl Ernst von Baer was the first to call attention to the remarkable agreement between the development of the individual and the development of the ancestral line to which the individual belongs. He showed that in every organism, as well as in its component parts, there is a gradual progress from the simple to the complex, from the general to the special. As Haeckel puts it: "Ontogeny is a recapitulation of phylogeny, or, somewhat more explicitly, the se-

ries of forms through which the individual organism passes during its progress from the egg-cell to its fully developed state is a brief, compressed reproduction of the long series of forms through which the animal ancestors of that organism, or the ancestral forms of its species, have passed from the earliest periods of so-called organic creation to the present time."

Thus, observation shows, as the theory of evolution demands, that the germs of all animals are, at the outset, exactly like each other; but in the process of development each germ acquires, first the differential characteristics of the subkingdom to which it belongs, then, successively the characteristics of its class, order, family, genus, species and race. For example, the highest mammal, man, begins his corporeal existence as a simple germ-cell in form and general appearance like an adult ameba, and utterly indistinguishable from the germ-cell of other vertebrates. As development progresses, the embryo gradually becomes more and more differentiated. In its earlier stages it may be recognized as the embryo of a vertebrate, but it is impossible to tell to which class of vertebrates it belongs. So far as appearances go, it may be that of a fish; a reptile, a bird, or a mammal. Subsequently it exhibits the characteristics of a bird or a mammal, but the order to which it belongs is disclosed only at a yet later period. At a still later stage, after manifesting the characteristics of the family, genus and species of which it is a member, it acquires the distinguishing attribute of its race.

21. Which animals resemble man most?

Considered physiologically, man is nearer related to apes than to any other mammal. The similarity consists in the structure of the bones, the mode of living, the motions, the functions of the organs of sense and taking care of the offspring, the secretion of the glands, the functions

of the heart and of all other principal organs. Even the articulations of the primates may be considered an initial step to human speech.

Retrospect.

Whether or not the first beginnings and germs of organic life have come from other celestial bodies or have developed in the manner described in sections 8 and 9, there is up to this day taking place a perpetual introduction and development of newly formed organisms, all of which have developed and are still being developed at different places under most varied conditions and are the prototypes of different types or groups of individuals, tribes and classes as is shown in fossils as well as in others which have never come to light, commonly termed missing links. Other organisms have failed to adapt themselves to new conditions and have become extinct.

Applying this mode of reasoning concerning life on earth to the origin of mankind we may safely assume that *all men* are *not descended from one prototype,* but that each group or each race has developed from a progenitor of its own at different times, in different places, in different zones under the most varied conditions.

Consequently those people ought to feel relieved who have believed that all human beings of all colors and types are descended from one Adam and Eve. So we may be more generous in the future by dealing out a separate Adam and Eve to each type or race of man.

22. Is there an essential difference between the soul of man and the soul of animals?

The difference is not in kind, but only in degree.

23. What do we call "soul"?

According to notions received from the ancients the

soul is separable from the body. However, modern science, finding expression in monism, defines it to be the *sum total of all manifestations* exercised *by the living organism*, thus being a synonym of character, propelling, driving force or energy governing the whole universe down to the minutest atom.

24. Where is the soul located?

The manifestations of the vertebrate, including man, meet in the central nervous system, finally in the brain. In invertebrate, many-celled animals, the soul functionates mainly in the ganglia which are connected by chords.

25. Do only the many-celled higher and lower animals possess a soul?

No—for if all higher organisms have developed from lower forms the difference in the quality of the soul or the manifestations of life is one of degree only and consists in the lower forms in sensitiveness to incentives from the immediate environment, the discharge and exchange of reciprocal emotions, the instinct of self-preservation and propagation of its kind. Noticing these manifestations in the most primitive, one-celled animals and plants both these organisms may as well be credited with a soul, which is inherent in the cellular body or protoplasma.

26. How, then, may these manifestations of human and animal organisms, the soul, be traced and demonstrated?

By tracing them from the highest organisms down to the simple cell body in the following manner: From the known sensitiveness characteristic to man and the highest vertebrates we come down to the unconscious sensitiveness of the lesser animals, then to the primary differentiation of the organs of sense, further down to the organs indifferent to the senses as found in the lowest many-celled and

the higher one-celled organism, finally arriving at the sensitiveness of the single cell body.

27. What does this ontogeny and phylogeny of the soul teach us?

The former takes us back to the simple cell soul. From there we reach a union of unconscious sensations and motions in the round cell-clusters of the unicellular colonies corresponding to the nucleus of the furrowed egg of the multi-cellular individuals. In all cases, however, whether the cell-unit lives freely as a unicellular organism or forms an integral part of a multicellular individual, it exhibits in itself all the phenomena characteristic of a living being. Each cell assimiliates food material, either obtained by its own activity, as in the majority of the protozoa, or it is brought, so to speak, to its own door, by the blood stream, as in the higher metazoa, and builds this food material into its own substance, a process accompanied by respiration, assimiliation and excretion and resulting in growth and development. Each cell exhibits in greater or less degree "irritability" or the power of responding to stimuli; and finally each cell, at some time in its life, is capable of reproduction. It is evident, therefore, that in the multicellular forms all the complex manifestations of life are but the outcome of the co-ordinated activities of the constituent cells. The latter are indeed as Virchow (1821-1902) has termed them "vital units." It is, therefore, in these vital units that the explanation of vital phenomena—including "soul"—must be sought.

28. Is the brain of man absolutely different from that of animals?

In degree. Generally speaking, the great brain, or the cerebrum and the hind brain or cerebellum of the mammals are more developed than the medulla oblongata, the

transitional part between the spinal cord and the other two parts of the brain proper. The most primitive forms of mammals still in existence have a brain very much like that of the amphibia and reptiles found in the oldest formations of our globe. The brain was fully perfected in animals living during the older tertiary formation, whilst during the recent, post-glacial formation, it reached its highest perfection in the primates and finally in man. The differences in the structure of the brain and the corresponding soul-life of man and the anthropoid apes are smaller than between the latter and the lesser or primitive apes and prosimiae.

29. Has only man sense?

Not at all. The association of ideas brought about unconsciously in primitive animals is effected more consciously by the more developed and so-called higher classes of animals and finally takes the form of simple ideas leading up to concrete association of ideas. The highest perfection is reached in man, who is endowed, through a chain of abstract association of ideas, with reason, the faculty or process of drawing logical inferences from premises.

Thus we speak of man as essentially a rational animal, it being implied that man differs from all other animals in that he can reason. It is, however, exceedingly difficult in this respect to formulate an absolute distinction between man and animal. Observation undoubtedly suggests that the latter has a certain power of making inferences. Between the higher animals and the lower types of mankind the distinction is so delicate that many psychologists argue that the difference is one of degree rather than one of kind. There can be little doubt, however, that inference by man differs from that of the brute in respect to self-consciousness, and, though there can be no doubt that some animals dream, it is difficult to find evidence for the presence of

ideal images in the "minds" of any but the highest animals. In the nature of the case it will be impossible to arrive at satisfactory conclusions as to the rationality which may be predicated of animals.

30. How about the much talked-of freedom of the will?

This human attribute as preached both by believers and unbelievers cannot hold out against the judgment of pure reason. Every activity and utterance of the soul as well as every act of the will is limited and conditioned by the organization of the individual on one side and by the influences from without on the other. The freedom of the will is only apparent and everybody acts according to the character or kind of pursuits acquired or inherited from progenitors. Circumstances decide at the impulse of the moment, but are limited by laws governing emotions, the strongest one usually prevailing.

31. What is thought of the immortality of the soul?

The third article of the Apostles' Creed reads as follows: "I believe....in the resurrection of the body and life everlasting." But belief in the immortality of the soul is just as untenable as belief in the freedom of the will. It is not even a constant tenet of all higher forms of religions. There is no mention of it in the Books of Moses, nor in the older books of the Old Testament written before the Babylonian Exile. The religions of Buddha and Confucius do not mention it. Then the belief is not inherited in man. Many primitive, uncultivated people know nothing of it, neither the Veddhas of Ceylon nor other aborigines of India, Australia and both Americas.

Belief in the existence and immortality of the soul has developed by pondering about life and death and especially through the dualistic conception of the human organism. However, against the belief of the immortality of the soul,

the resurrection of the body and an eternal life science makes the following claim: The soul is not an immaterial body with extraordinary properties, as mentioned before, but it is the sum of emotions characteristic of the constitution of the parts of each individual, especially of the central nervous system and therefore ceases to function at the expiration of the individual; moreover, whereas chemists and astronomers have discovered distant bodies and have ascertained their constituent parts, no scientist has ever succeeded in discovering or locating former inhabitants of earth or any of their component parts.

The Spiritual World.

32. How does man look for truth?

In a twofold manner: By learning to find out and by believing what is taught him.

33. What are the sources of our knowledge?

Impressions which we receive from different sources through our organs of sense and which are associated with previous knowledge gained by aid of the reasoning faculty the seat of which is the brain.

While we do not know positively the first and innermost causes and principles underlying all things we accept as true and real whatever we perceive through our own organs of sense and whatever has been proved by or is based on established scientific facts, observations and calculations.

34. What do we mean by belief or faith?

Adhering to ideas, perceptions, notions and traditions the truth or existence of which has or has not yet been proved and established.

35. Is there a belief or faith in science?

Certainly, there is and there has to be, for it is indispensable to all scientific and research work undertaken under the guidance of established and proven facts. It will adhere to all theories and hypotheses based on a number of deductions and explanations until the latter may be disproved or displaced. . . .

51. Is there room for a creed founded on pure science and natural philosophy?

Yes, it would be a creed unifying the conception of the spiritual with that of nature substance. More than a thousand years before Christ, the first seeds of a unification have been spread in India, Egypt, China and Japan. Some of the Greek philosophers have been imbued with the spirit of a philosophic religion or religious philosophy.

52. Does monism satisfy reason and the human mind?

It ought to, because it is based on secure, tangible and visible foundations laid throughout the universe, on facts, events and phenomena partly anticipated, not fully understood by previous generations, but finally proven beyond a doubt by exact science, modern discoveries and researches, achievements refuting at the same time old traditions and beliefs as related in documents and books forced on us as being inspired. Unbiased and unprejudiced people ought to feel relieved now, the road having been paved toward a better and a clearer understanding of nature, enabling all of us to grasp and interpret the problems of life, the ideals of truth, usefulness, morality and beauty.

53. How may we attain the ideal of truth?

By striving to understand and to learn to connect natural phenomena with their causes and effects.

54. How may we attain the ideal of morality?

By following the golden rule first enunciated by Confucius 500 years before Christ in these words: "What you do not like when done to yourself, do not do unto others," or expressed directly: "Treat others as you expect to be treated."

This is the plainest, straightest and most effective policy leading to an exemplary, virtuous life.

55. Where does the monist look for his ideals of beauty?

In the beautiful forms of nature and in the products of human skill as far as the latter are true imitations of nature and adapted to some purpose or end.

OTTO HERRMANN.

BOSTON, MASS.

"INTERLINGUA" AND THE PROBLEM OF A UNIVERSAL LANGUAGE.

IT might be thought that the construction of an artificial language was a product peculiarly characteristic of our mechanical age. The very notion calls up an image of august congresses with bespectacled professors haranguing, of sheaves of printed circulars, of motions proposed and rescinded, of heat and recrimination. As a matter of fact the idea goes back to the dawn of modern science. Descartes played with it: "It will help peasants," he said, "to judge better than philosophers now can of the truth of things"—a claim which is perhaps not so far-reaching as it looks at first sight. It engaged, as is well known, the powerful and versatile mind of Leibniz. But I do not propose to give here an account of the older projects previous to the efflorescence of language-making which took place in the latter part of the nineteenth century, and must refer readers who desire information on this subject to such works as John Venn's *Principles of Empirical or Inductive Logic* (1889), Couturat's *La logique de Leibniz* (Paris, 1901,), Couturat and Leau's *Histoire de la langue universelle* (1903), Dr. Alberto Liptay's *Eine Gemeinsprache der Kulturvölker* (1891), and W. J. Clark's *International Language: Past, Present and Future* (London, 1907). Nor have I space fully to describe even the modern movement. My object is merely to examine the merits of one particular universal language, that called "Interlingua,"

of which Prof. Giuseppe Peano, of Turin, the founder of modern mathematical logic, is the most prominent advocate.[1] But in order to understand the nature and objects of this language, it will be necessary, first, to take a summary survey of the process by which it has been evolved from its predecessors, of which the first was Volapük.

* * *

Volapük, now more effectually dead than Greek or Latin, without the sweet savor of either, had a brilliant but short career. It was the creation, like its successor Esperanto, of one man, having been invented by J. M. Schleyer (now Monsignore), a clergyman at Linzelstätten in Baden, who promulgated it in 1880. Its success was rapid; a few years saw the establishment of hundreds of Volapük societies in all parts of the world, and at one time there were 25 periodicals printed in Volapük. Its decline is to be ascribed largely to its highly artificial and arbitrary vocabulary, and to the competition of Esperanto (1887), a far better language, which combined the merits of Volapük—the regularity and simplicity of its grammar—with a less repulsive vocabulary. The name Volapük itself illustrates its chief defect; it is a mysterious deformation of *Weltsprache*. The grammar required all substantives to begin and end with consonants, and the memory was burdened with barbarisms like *fablüd* (= fabrik), *tlup* (= troop), and *blod* (= brother).

The Volapükists invited all friends of the universal language movement to an international congress, held at Friedrichshafen in 1884. At the second congress, held at Munich in 1887, a Universal Language Academy was founded, with the objects of preserving unity and perfect-

[1] This paper was undertaken at the instance of Professor Peano himself, who welcomed it as a means of bringing Interlingua before the public of the United States. But of course Professor Peano is not responsible for any of the views or statements contained in it, with some of which he would doubtless disagree.

ing Volapük, and it is from this body that the "Academia pro Interlingua," of which Professor Peano is director, is descended. The first director of the Academy was Prof. Dr. August Kerckhoff of Paris. He at once set to work with great diligence, and by the beginning of 1889 much had been done towards preparing a new grammar and vocabulary. But at the Paris congress of 1889 rifts already began to appear. Schleyer, the founder, who had been given the ornamental post of *Obervorstand,* would hear of no important changes; the director and the academicians quarrelled; the various Volapük societies and journals had begun to split up into factions; and a mass of grammatical projects, which the organization was incapable of sifting, poured in upon the Academy. The result was that interest and propaganda quickly died away. In 1891 Kerckhoff resigned, and in 1893 the election, by a provincial committee, of Woldemar Rosenberger of St. Petersburg as director, was confirmed. He proceeded to reform the vocabulary by restricting it as far as possible to words already international (for instance, instead of *blod* he proposed *frat*; Mr. Plum of Copenhagen, however, preferred *fratr*). Investigation showed that there are about 8000 word-stems common to English, French, German, Italian, Portuguese, Russian and Spanish, and accordingly it had by now become the practice for all artificial languages to select their word-stems as far as possible from the living languages and from Latin, preference being given to the stems common to most languages. The grammar also was re-modeled, and under Rosenberger's auspices the work of the Academy took a new lease of life. Meanwhile a number of other languages had sprung up, many of which influenced the deliberations of the Academy. Of these the principal were, according to Rosenberger,[2] the following:

[2] W. Rosenberger, *Wörterbuch der Neutralsprache,* Leipsic, 1902, p. 300.

1. "La lingvo internacia," Dr. Esperanto (Warsaw), 1887.
2. "Kosmos," Eugen A. Lauda (Berlin), 1888.
3. "Spelin," Prof. J. Bauer (Agram), 1888.
4. "Myrana," J. Stempfl (Oberreuth, Bavaria), 1889.
5. "Lingua internazional," J. Loth (Vienna), 1890.
6. "Universala," Dr. Eugen Heintzeler (Stuttgart), 1893.
7. "Novalitiin," Dr. E. Beermann (Nordhausen), 1895.

The list is interesting as showing that the age was as fertile in artificial languages as in patent foods, and indeed many of the names would fit the one product as felicitously as the other. The point to be noticed about the academic language thus evolved is that it differed essentially from previous artificial languages in being, not the creation of an individual, but the result of the labors of an international society. It preserved the Volapükistic principles of almost completely phonetic writing, of no exceptions to rules, and of simplicity and ease in forming derived words from the given radicals; and it was much easier to learn than Volapük, because most of its words were immediately intelligible to all educated Europeans and Americans. In 1898 the Rev. M. A. F. Holmes, of Macedon, N. Y., was elected director of the Academy, and "Idiom Neutral" was adopted as the name of the language.

Volapük was thus completely transformed. But the independent growth of a host of other languages, and particularly of Esperanto (as the language invented by Dr. Zamenhof of Warsaw had come to be called, from the pseudonym used by him) had produced a situation which became acute in the opening years of the present century. In the autumn of 1907 an international committee met in Paris, to choose the best system. Most of the members were people who at least coquetted with Esperanto; yet they could not deny its grave faults, and a com-

mission was accordingly appointed to draw up an improved Esperanto, which was subsequently called Ido. More than nine-tenths of the Esperantists refused to accept the reforms, and nearly all the adherents of other systems decided to work further on a scientific basis. The most prominent joined the original Universal Language Academy, which, under its present name of "Academia pro Interlingua" had been breaking new ground, not by concocting yet another artificial language, but by taking Latin and divesting it of its flexions and complicated grammar.[3] In 1911 the Academy consisted of more than 100 members in Europe, America, Asia and Oceania, including 18 university professors.

There thus exist to-day two main divergent tendencies, both the fruit of the movement that began with Volapük. On the one hand we have in Idiom Neutral, Esperanto and Ido, the attempt to create languages, each fulfilling more perfectly than the last the ideal of being completely rational and easily intelligible, in theoretical independence of any one natural language. Interlingua, on the other hand, while inspired by much the same ideals, seeks to attain them by a different method: it is not a purely artificial language, but tries to secure the same simplicity and intelligibility, and perhaps also the same thorough-going rationality as the artificial languages, by taking one natural language, Latin, and cutting away all its irrational elements, its complications and anomalies. Before we compare the merits of these two systems, it will be well to clear our ideas by shortly considering the principal conditions which a language must fulfil to be completely "rational." In doing this I shall refer only to Ido; for Esperanto, which was widely diffused until recently (especially in Russia, where it was enthusiastically welcomed by Tolstoy), appears now

[3] See two papers by Professor Peano: "De latino sine flexione," *Revue de Mathématiques*, Vol. VIII; "Il latino quale lingua ausiliare internazionale," *Atti della R. Accademia delle Science di Torino*, Vol. XXXIX, Jan. 3, 1904.

to be on the decline, and is generally admitted to be inferior to Ido, which, as is well known, enjoys the support of the eminent mathematician, logician and philosopher, Dr. Louis Couturat.

* * *

1. Perhaps the most important principle which an ideally rational language must observe is that which may be called the *principle of maximum analysis*. On a superficial view it looks as if English, when it takes six words, "those who are about to die," to express what in Latin only requires one, "*morituri*," were a degraded jargon as compared with Latin. But in fact, though the extreme synthesis of Greek and Latin permits the most fascinating refinements of style, this tendency of modern languages to express each separate idea by a separate word is a great step forward in evolution, both as approximating speech to the ideal of a logical symbolism, and as enormously simplifying grammar. Leibniz already perceived this: "In grammatica rationali necessarii non sunt obliqui, nec aliae flexiones."[4] An artificial language, therefore, will carry to its utmost limits the process of getting rid of all flexions, such as the case-endings of substantives, adjectives and pronouns, and the personal, temporal and modal inflexions of verbs. Leibniz even suggested that a plural sign was unnecessary,[5] but this may be doubted, though some natural languages do sometimes dispense with it, e. g., German "*tausend Pfund*." The truly rational language will be even more analytic than English, for English, though the best of the major European languages in this respect (perhaps agglutinative languages like Chinese are better still), is still far from perfect; for instance, we unnecessarily keep such oblique cases as "him," "them," "her," and such plural forms as "these," "those." Now it may be observed at

[4] Couturat, *Opuscules et fragments inédits de Leibniz*, Paris, 1903, p. 287.
[5] *Ibid.*, p. 281.

once that Ido falls short here. In its verbs, while abolishing the personal flexions, it keeps a full set of flexions for the three tenses of the indicative (*me kredas*, I believe; *me kredis*, I believed; *me kredos*, I shall believe), and also for the three corresponding infinitives and participles (present infinitive, *kredar*; past infinitive, *kredir*; future infinitive, *kredor*; present participle, *kredant*; past participle, *kredint*; future participle, *kredont*). Dr. Couturat regards this as a merit,[6] but I think that the logic of it, though symmetrical, is shortsighted. On the principle of maximum analysis we need no separate tense- or mood-forms for the future, nor, probably, for the past: all can be expressed by combining different auxiliaries with a single fixed verb-stem. A present participle active is probably necessary, but past and future participles active are certainly not. Similar remarks apply to the retention by Ido of inflexions for the imperative, conditional and subjunctive moods. In English the absence of a flexion for the imperative is not found troublesome: when necessary the symbol ! can be used to mark it.

The principle of maximum analysis abolishes that part of grammar concerned with the declension of verbs, regular and irregular, and substitutes fixed verb-stems and a few auxiliaries, by the combination of which all the required moods and tenses can be expressed. Also, for the synthetic method of expressing relations by means of case-endings (e. g., "Ich gab *ihm einen* Kuss") it substitutes the analytic method of prepositions, already carried far in English ("I gave a kiss to him"). Thus Dr. Couturat suggests[7] that even the accusative case might be expressed by a preposition, as, he might have added, is actually done in Spanish. But this remark, together with our last example, indicates an obvious limitation on the principle of maximum anlaysis

[6] "Sur la structure logique du langage," *Revue de Métaphysique et de Morale*, Jan. 1912, p. 15.

[7] *Ibid.*, p. 21.

—a limitation which may be formulated as the *principle of uniformity of position*.

2. If an unrestricted range be given to the principle of maximum analysis, we should always have one word for each separate concept. But this would be intolerably cumbrous in practice; the functions of speech are not the same as those of a logical symbolism, and we wish our language to have as much esthetic merit as is compatible with precision. Now cumbrousness can be avoided without loss of precision by invoking the *principle of uniformity of position*. That is to say, we shall have fixed rules (they will be few and simple) according to which the meaning of a sentence will depend partly on the relative positions of the words in it. All languages use this principle, some more than others, and it is not unknown to symbolic logic. In English, for instance, in "I gave him a kiss," we avoid *both* a special flexion for the dative case, *and* the expression of it by a preposition, by assigning to the pronoun a definite position in the sentence. It is obvious that this device, perhaps the most ingenious of all linguistic triumphs, makes the allocation of a preposition to the accusative case superfluous: that case can always be expressed by the mere fact of its coming after a transitive verb. No doubt ambiguities will sometimes occur (e. g., "I love him more than you"), but even a rational language may safely leave something to the context. But the importance of this principle, from the point of view of economy, lies in the generality of its application. When it is said that the meaning of a sentence depends on the relative position of the words in it, I include under "words" what are usually considered as parts of words—namely affixes, suffixes and particles. Thus, in English, such suffixes as -al, -ality, -ous, -ousness, -hood are really words standing for general concepts, which, combined in a certain position with other words, express concepts of less generality. An artificial

language will copy this feature of natural languages, but whereas the natural languages, owing to the accidents of growth, perform the process with infinite irregularity and caprice, it will do it systematically and uniformly. For instance, "what can be . . . ." will be expressed by one symbol added to verbs (Ido, *-ebla*: *manjebla* =eatable), and "what ought to be . . . ." by another (Ido, *-enda*: *punisenda* = what ought to be punished). In English the absence of some such symbol as the last has caused an ambiguity with serious consequences: "desirable" has to do service both for "what can be or is desired" and also for "what ought to be desired," whence J. S. Mill and others could plausibly identify what is desired with what is good. And in France it is conceivable that one might be hanged under a misapprehension, for no one knows whether *pendable* = "what can be hanged" or "what ought to be hanged." Other suffixes and affixes in Ido are *-eso* = "the fact of being so and so" (*beleso* = beauty, *avareso* = avarice); *-ozo* = "full of" (*kurajozo* = a brave man); *-ajo* = "ness" (*blankajo*, whiteness, *vakuajo* = a vacuum); *-iv* = "capacity for" (*resist-iv-eso* = capacity for resistance); *-em* = "tendency to" (*resist-em-ezo* = tendency to resist); *-atr* = "participating in the nature of" (*sponjatra* = sponge-like); *-al* = "relative to" (*religiala milito* = a war of religion, whereas *religioza milito* = a religious war); *ne-fidela* = faithless; *des-ordino* = disorder; *-ega* = augmentative (*grandega* = enormous); *-eskar* = inchoative (*dormeskar* = to fall asleep); and so on. These examples show how in an artificial language groups of cognate words can be formed on a regular system, thus avoiding the ambiguities that attend the formation of such compounds in the natural languages; and they also illustrate (a point to which I shall return) one of the ways in which a rational language must be most conspicuously artificial.

We may accordingly sum up the superiority, in point

of rationality, of an artificial language over any natural language, under the above two main heads. It is, or should be, more analytic, and more consistently so, than any actual language; its grammar should be capable of being written on a half-sheet of note-paper. And, by remembering the rules governing the relative positions of words and parts of words, it should be possible to detect with certainty the precise meaning of any sentence. These features make it easier than any foreign language to speak, write and understand accurately.

* * *

We are now in a position to answer the question, How does the semi-artificial Interlingua compare with a purely artificial rational language? I shall try to show that, while there is not much to choose between them as regards their observance of the principle of maximum analysis, Interlingua must, as long as it remains only semi-artificial, be inferior as regards observance of the second of the above principles. But it does not follow that it is either better or worse on the whole as a universal language. To decide that question we shall have to take into consideration other factors independent of our two principles: it may be an easier language for other reasons; and much depends on the purpose for which it is intended.

And, first, as to Interlingua's observance of the principle of maximum analysis. The Academy has not yet (October, 1912) decided on the flexions of verbs, but there are indications that it will not make as clean a sweep of them as is made even in English, and that thus it will not observe our first principle more closely than Ido does. It has been decided to adopt for the indicative of all verbs the Latin 2d person imperative singular; and the person-endings, singular and plural, are of course discarded, as in Ido. Thus "I love" = *me ama*, "you love" = *te ama*, and so on. But I observe in the journal *The International*

Language for August, 1912, (edited by Gerald A. Moore, London) that special forms are used for the conjunctive and infinitive moods: for instance, *esserè possibile adoptare* = "it would be possible to adopt"; and a prominent supporter, J. B. Pinth of Luxemburg, proposes other forms for the future, the present participle active, and the imperative.[8] On the other hand, Professor Peano told me in conversation that he used no flexion for the future, but expressed it by an auxiliary. In the case of substantives, adjectives and pronouns, the Latin ablative singular is used for all cases, the plural being indicated by the suffix *-s*. However, one of the great merits of Interlingua is its elasticity; every one can be left, within wide limits, to use as few or as many flexions and other grammatical forms as he pleases, without being any less readily understood by any one who has learned Latin; and we may therefore hope that the Academy will refrain from officially fixing a set of verb-flexions which, besides violating logical purity, would be of no practical use.

Secondly, as regards the principle of uniformity of position, I am not aware that the Academy has considered any proposals for determining the meaning of a word by its position in the sentence, or for the regular derivation of cognate words from one another by means of suffixes and affixes. Indeed it seems that in this last respect Interlingua must from its nature be inferior to a purely artificial language. Take, for instance, such a group of English words as elect, elector, election, elective, electioneer, electioneering. A purely artificial language will represent all the members of the group by suffixes arranged on some logical principle of derivation, but Interlingua cannot do this without abandoning its Latin character to such an extent as to be practically indistinguishable from Ido or Neutral. For one of

[8] J. B. Pinth, *Die internationale Hilfssprache Interlingua*, Luxemburg, 1911, p. 6.

the chief ways in which modern European languages have developed and are developing every day, is by forming new words, as new meanings are required, by piling up suffixes on the top of old words (for instance: utility, utilitarian, utilitarianism; intellect, intellectual, intellectualism, intellectuality), and the number of new words created by this process is so great that Interlingua is in a dilemma. Either it must form such compounds for itself, only on a logical plan, and not haphazard like the natural languages; or it must get round them by periphrases. In the latter case it will be as inapt for the expression of living thought as classical or medieval Latin; in the former, its vocabulary will be nearly as much inflated with purely artificial products as Ido or Neutral, and it will lose the specific element of Latinity which distinguishes it from such languages. For, if it does adopt some rational system of deriving cognate words from one another, it is hard to see in what way it will differ from, for instance, Ido. It will not differ greatly in vocabulary. The first two resolutions passed by the Academy in 1910 are (1) That Interlingua shall have a vocabulary as international as possible, and as little grammar as possible, and (2) That all words common to English, German, French, Spanish, Italian, Portuguese and Russian shall be adopted. Now all the purely artificial languages that are up-to-date aim at having a vocabulary as international as possible; and we have seen that the grammar of Interlingua is little, if at all, simpler than theirs. Nor does the third resolution of the Academy—That all Anglo-Latin words (some 55,000) be adopted—differentiate it: the best artificial languages also adopt these words, with the result in practice that both they and Interlingua are dialects of Neo-Latin. We shall therefore await with interest the carrying out of the Academy's fifth resolution: That a vocabulary of the words not defined by the above resolutions be prepared; for the nature and bulk

of this supplementary vocabulary should be decisive of the future character of the language. If a layman may express a hope, it is that the above-mentioned dilemma will be escaped by leaving each Interlinguist to form his compound words for himself, *not* on any logical plan, but haphazard, as seems most convenient. It is true that in that case Interlingua must, *pro tanto,* renounce the hope of being completely rational, and consequently of being universal in one of the senses in which the artificial languages aim at universality; but I shall argue presently that this is not a disadvantage.

Meanwhile two minor points of interest may be noted. The Academy has decided to adopt the usual nomenclature, already to a great extent internationally standardized, in botany, zoology, chemistry, etc. This, as enabling it, for instance, to preserve the universally recognized symbol Cl. for chlorine, gives it a distinct superiority over Ido, which calls chlorine *kloro.*

The Academy has resolved that the articles, when useless, ought to be suppressed. Probably they are more often useful than not, though there are no articles in the Slavonic languages. Many Interlinguists use *il* (contracted from *ille*) to represent the notion, so important logically, which is denoted in English by "the."

* * *

The advocates of Interlingua claim that it is superior to any of the purely artificial languages, because (1) it is more analytic, and (2) it deforms the international vocabulary less excessively. But we have seen that, as at present written, it does not seem to be markedly more analytic than Ido; and that, if it refrains from deforming the international vocabulary, it must be at the cost of being less completely logical than an artificial language. At the same time, its superiority to the purely artificial languages must, I think, be admitted; but this superiority depends (and its

supporters do not seem to notice this) on its not trying to be a *universal* language in any broader sense of the word. That is to say, it is certainly more readily intelligible and more easily managed by any one who knows a little Latin than any of the purely artificial languages, and this fact makes it better fitted than any of them to serve as a medium of communication between men of learning and science of different nationalities. Any one who knows a little Latin can at once understand the following. "Volapük es mortuo ab Esperanto, isto es in periculo per Ido; quale solutione es possibile post 'latino internationale'? Nullo alio; nam isto plus non contine uno elemento arbitrario, et habe simplicitate in grammatica superiore multo ad Volapük, et ad omni derivato."[9] But it does not seem to be generally realized that it can retain this advantage, which makes it a handier substitute for the scientific dog-Latin (such as Euler's) of the 17th and 18th centuries, only so long as its ambition is restricted to being universal in this narrower sense of being a *lingua franca* for savants. For there are two other principal senses in which a language may be called universal, and it seems (unfortunately, as I think) that Interlingua is intended to be universal in these senses as well.

A language may aim at being universal in the sense of Leibnitz's "universal characteristic." Professor Peano, though he goes on to notice the essential difference between a language and a system of logical notation, seems to have this aim in mind when he describes as follows the process by which he produced his "Latin without flexions": "The study initiated by me is based on a series of logical equivalences, containing in one member one word or one flexion, which is not contained in the second member. Hence, if we substitute constantly the second member for the first,

[9] Proceedings of the *Academia pro Interlingua*, Vol. III, 1912, p. 155, Turin.

we can remove from Latin that word or that flexion. Proceeding thus, we shall arrive at determining what is the minimum number of words, affixes and suffixes, sufficient to express all ideas, and we shall thus construct the *minimum Latin*. This method is an application of mathematical logic, which, by a succession of equivalences, permits the decomposition of a totality of mathematical ideas into primitive and derived ideas."[10] I have pointed out that this task is performed by the purely artificial languages also, and more completely by them than by Interlingua, and that, if Interlingua emulates them in point of complete rationality, it is bound to deform the international vocabulary as much as they, and thus to become equally difficult, even to people who know a little Latin.

Now evidently a language might be perfect as a "universal characteristic," and yet be used by only a few people. Interlinguists, however, often speak as if they intended their language not only to be as completely rational as possible, nor to be merely an auxiliary language for the learned, but also to aim, as do the purely artificial languages, at being universal in the further sense of being used by every one who comes into contact with people of other speech than himself; they wish it to serve as an international medium for commerce, travel and the publication of works of literary art. Thus the veteran *Weltsprachler*, Josef Bernhaupt, in a message addressed to the Academy, writes (sinning unnecessarily against the principle of maximum analysis), "Artista, advocato, filosofo, medico, oratore, poeta, professore, sculptore, etc., debe potere exprimere seos cogitationes et seos sentimentos cum maxima precisione et sine ulla difficultate. Si Interlingua non habe ista qualitate, illa vale nihil et non poterà essere, et non sarà in ullo tempore, lingua de tota humanite."[11] It seems

[10] Peano, "Il latino quale lingua ausiliare internazionale," *Atti della R. Accademia delle Scienze di Torino*, Vol. XXXIX, Jan. 3, 1904, p. 9.

[11] Proceedings of the *Academia pro Interlingua*, Vol. III, 1912, p. 146.

to me that this inclusion of all mankind, the grand object of all makers of universal languages, is chimerical; that it is not possible of attainment, even if it is desirable; and that its advocates tend greatly to exaggerate the benefits that would flow from it, were it attained. I may perhaps be allowed, in conclusion, to say something on these points, in order to justify my hope that Interlingua will not, by aiming too high, throw away the opportunity which it has of doing service to mankind.

* * *

The reason for thinking it impossible to establish an artificial language which shall be universal in this wider sense is drawn from experience, and is therefore not conclusive; it does, however, raise a strong presumption, since the history of such languages since 1880 seems to show that a general cause is at work to produce their rapid rise and equally rapid decay. The idea, once launched by enthusiasts eager to promote the spread of knowledge, the fraternity of mankind and "the federation of the world," is taken up by large numbers of the moderately leisured classes, and the construction of an idiom free from the absurdities of a natural language goes on apace. But presently inconsistent projects, whether in grammar or vocabulary, engender hostile sects, the organization breaks down, enthusiasm languishes, and the ground is left clear for some new construction, which in its turn will suffer the same fate. It seems, in short, inevitable that different sections of the public should prefer different words and different grammatical forms. No central committee is likely to be strong enough to reconcile the dissentients; if it is tactful (and committees tend to be tactful) it will enact a compromise disgusting to all alike. It may be argued that Interlingua, not being a purely artificial language, is exempt from this doom. I have tried to show that if it claims at universality in the same sense as the

artificial languages, as there is danger of its doing, it must become as artificial as they, and it is a fair inference that in that event its history will proceed on the same lines.

But, even if we suppose the practicability of a universal language in this wider sense, is it after all a thing so greatly to be desired? It is usual to speak as if it were not only highly desirable but a necessity. The modern growth, it is said, of international intercourse, caused by steam and electricity, has been accompanied by no corresponding increase in the ease with which men can communicate their ideas; a universally intelligible medium is now as necessary as the telephone or telegraph; and such a medium, by in turn reacting favorably on international trade and communication generally, would advance the cause of universal peace. Another argument is that increased international intercourse makes it more necessary than formerly for large numbers of people to learn several foreign languages, and that, all of them being illogical and complicated, this involves a strain on mental energy and an overweighting of the curricula of schools, which would be saved by the acceptance of one single universal idiom.

I do not want to deny that there is something in these arguments, though perhaps, if space allowed, it might be shown that there is not as much in them as is usually thought. What I want to point out is that, if we accept them as conclusive, a consequence follows which the advocates of a universal language always seem to disregard, —namely that we must give up something which is undoubtedly of great value. That many people are forced by their vocation to learn one or more foreign languages, which *ex hypothesi* they would not learn if there were a universal language, is certainly a great good, since in this way a certain measure of insight into one another's mental life and traditions, and some appreciation of one another's literatures, are fairly widely diffused among all polite com-

munities. These collateral advantages accrue, for instance, to every scholar and man of science and to every trader who learns a foreign language because it is necessary for his particular study or trade, and in proportion as the *Weltsprachler* attain their ideal these advantages must be lost. The question we ought to ask ourselves is, whether we can be sure that the benefits caused by a universal language, supposing it established, would outweigh or even be equal in value to what must be lost in the process.

It is too often forgotten that in this world many things desirable for their own sakes are in fact incompatible with one another, and whoever considers what sort of things *are* thus desirable, must feel that the answer to our question is at least very doubtful. Now acquaintance with a foreign language is, quite apart from its usefulness, one of those objects that are desirable for their own sakes; for one thing, all natural languages (even German) have peculiar beauties of their own, whereas few will maintain that an artificial language, however rational, is capable of the same kind of beauty as the rude natural growth. It may indeed be said that a rational language has that sort of esthetic merit that comes from perfect logical precision,—that it is impossible, for instance, to make a pun in it. To this it may be replied that people have the language they deserve: if their ideas are logical, their language will serve their turn well enough, and no study of a rational language can be a short cut to clear thinking.

To sum up. The value of universal acquaintance with an artificial language seems to consist almost solely in the fact that it would be a means to other valuable things, such as increased international intercourse. But a large part of the intrinsic value of these very things consists in something which the artificial language, if it is to be effective as a means, must destroy,—namely the knowledge of foreign languages which large numbers of people are at pres-

ent forced to acquire. And it is impossible to feel sure that among the effects produced by a universal language would be any whose value would make up for the loss of this knowledge.

This argument, however, does not apply to Interlingua, provided it accepts the more modest rôle, for which it is admirably fitted, of a medium in which scientific works may be published and correspondence be carried on between the learned. The usefulness of such a medium is obvious. If there are any writers so hard-pressed that they must forego the advantages incidental to learning to read three or four foreign languages, they would still be able to keep up with the work of their foreign colleagues; the expense and labor of translations would be saved; and the profits of authors and publishers would be increased, because an international public would make large editions possible, and the cost of production would be proportionately diminished. Such are some of the benefits that may be expected, if a simple form of neo-Latin, easily intelligible to educated people, can be brought into general use; but they seem likely to be lost, if, sacrificing the substance to the shadow, the Academy tries to rival the universality of the purely artificial systems.

SYDNEY WATERLOW.

LONDON, ENGLAND.

THE AGNOSTIC.

I.

With all my being I desire to know,
Nor shall imagination's tempting glow
Lure me from reason's firm and upward road
To plunge into that vapor-haunted wood,
Where thought is lulled to sleep by heart's desire,
And fungus-lights of faith replace the fire
Of truth's lone beacon shining far on high,
In pure untainted air of reason's sky.
For ages I have struggled toward that light.
From age to age its radiance grows more bright.
A thousand centuries but mark the youth
Of thought that ever seeks eternal truth.
Far, far beyond me gleams the beacon true,
Now near and clear, now almost lost to view
When self-born tempests raise a misty cloud
To veil the eye of reason with its shroud.
Some vantage-points I've gained through centuries slow,
Some truth is mine, the most is yet to know.

II.

What know I of the dawn of life sublime,
That point infinitesimal of time,
That makes the unborn babe a separate "I"?
One instant but a growth, wherein doth lie

A balanced potency, to live or die,
The instant next an entity, a whole,
Beyond the mother's knowledge or control!
What unknown power has weighted down the scale
Of life, to make its potence of avail?
Imaginative creeds perchance may say
That in that moment ripe some soul astray
Or else predestined, enters here to stay.
I too may dream of things that might be so,
But reason says, "The cause not yet we know."

III.

Is death the end of this intrinsic I?
This conscious self that still demands the why
Of all things, and insists upon reply?
Shall individual consciousness be lost
When worn or broken body pays its cost?
When the machine fails shall the motive power
Be also lost?—Is life then but a dower
Of universal force, transmuted to this form,
Evolving in the ages from the worm
Through better mechanism, to man's estate,
Where for the moment it must culminate?
Shall individual life be merged, at death,
In that great unit force that gave it breath?
Materialism says "This must be so!"
Agnosticism, "This not yet we know."

IV.

The consciousness of individual soul
Is so deep-rooted that it must control
The thought that aims to scale these dizzy heights:
Reason may not surrender all its rights
To immortality. It cannot see

What lies beyond the mortal boundary.
It cannot know the things not of its sphere;
No word of "after-death" can reach its ear;
For if a spiritual life exist
It is not human, and cannot persist
In human functions when its mortal frame,
The outward form that gave it human name,
Is absolutely changed by nature's law,
Disintegrated and returned to feed the maw
Of newer life that lives upon the old
And still springs upward from the chemic mold
To follow nature's never-varying round
Of life destroyed, that life may more abound.
The spirit, if it live, has lost its kin
With kindred spirit still immured within
A fleshly tabernacle. No appeal
Can be received by mind still under seal
Of brain capacity that cannot hear
Aught but what speaks through human reason's ear.
Therefore, perhaps, no evidence has come
From that unknown that lies beyond the tomb;
No voice authentic from the dark abyss
To which each soul must plunge at death's cold kiss.
There can be no report for "Yea" or "Nay."
No evidence that pointeth either way.
I claim no faith, but while for truth I grope
'Tis not unphilosophical to hope.

V.

What of the God that reason's mighty aid
Imagination, has each age portrayed
In man's own image, to make good the call
Of reason, for a primal cause of all?
In man's own image, so that self-bound man
Worships himself, with but a larger span!

"God is the greater I, my self-made rod
Projected infinitely, measures God."

The law-bound reason, circling for a cause,
Confronts itself and its own changeless laws.
Nothing can be self-caused, yet time and space
Must be eternal, as the reason's base.
Therefore the higher pantheism taught
That time and space are God, through whom is wrought
The universe, and that the natural world
Is but God's effluence to man unfurled;
That man himself, the individual I,
Is but a reflex of God's entity.
My reason finds some fallacy in this,
The juggled words of false philosophies.
It sees imagination's hand disguised
By glove of sophistry, half recognized.
It lingers o'er that hand that seems to hold
The answer to its questions manifold.
But deeper thought provokes the judgment slow.
"This may be truth, but this not yet we know."

VI.

What is "the faith"? Saint Paul, the subtle Greek
Has made an answer, but in vain we seek
For any meaning in that wily phrase
Which to the ear of reason still conveys
The "tinkling brass and sounding cymbal" noise
Of words that aim to baffle reason's poise.
The words are hallowed by the centuries
Of faith that leans upon authorities;
The same old faith that heard the *Latin* voice
Of medieval monk or priest, and did rejoice
In that supremacy of sounding word
That spoke of supernatural to the herd,

Who, like the silly sheep obey, and hark
To crook that promises or dogs that bark.

The man agnostic cannot quite disown
The heritage of faith that was his own.
Born in him, parted from, perhaps with pain,
But never to be of himself again.
It lingers from the youthful memory still
In those strange dreams that override the will.
I too have felt the spell of Paul's strange word
Upon the heart, when outer ear has heard
The deep-voiced organ's diapason note
Make tremulous the air, and when the throat
Is closed by feeling's tide that rises high,
And for the moment clouds the reason's eye.

So, much religious faith has had its birth
In the emotion, and is only worth
Emotion's value, not to be disdained,
But to be tested, and to be restrained
When reason asks, "How know I this is so?",
And hears the futile phrase, "Believe, and thou shalt know."

Religious faith can claim a parentage
Of crude imagination, in each age
Fostered by ignorant zeal or crafty skill
To stifle reason, and to make the will
Of man bend pliant to a mighty power,
Dreaded because unknown, as in the hour
Of half-awakened sleep we seem to see
The known, as unknown, and may even be
Half frightened by the spectral shape that leaps
From out the dream that grows while reason sleeps.
So faith has built her insubstantial homes;

While reason sleeps she rears her airy domes,
Founded sometimes upon the heart's desire,
Sometimes the fear of an eternal fire.
When reason wakes they totter to their fall,
But baseless vision fabrics, one and all.

The past is strewn with ruins of her fanes,
Often, like ancient towns, built on remains
Of older faiths, so that the mind can trace
Religion's evolution in the race.

One faith is mine, the faith in law supreme,
The continuity of nature; if it seem
That things called "supernatural" arise
They know a law still veiled from human eyes.
As yet we see but darkly, but we know
That law must still control the ebb and flow
Of all things, as it does the ocean tides;
Changeless, eternal law that still abides.
That that which is, has been, and still shall be
The same, to uttermost eternity.
This is the scientific faith, based on the truth
Of all that man has learned since reason's youth.

VII.

Is life worth living without after-life?
Is self-thought all that holds us to the strife?
Does love of wife or child give less delight
Because we fear to lose them in the night
Of unknown death?—Nay, rather "while we live
Take all the joys that death and life can give."
Not in the Roman singer's careless strain,
Nor even subtle Omar's deeper vein,
But in the higher thought that life is ours

To live completely, to use all the powers
Within us to make life of some avail
To self and others, if at last we fail
To carry self beyond the body's death
We still remain immortal in the breath
Of every word and act of ours on earth,
Whether or no we recognize their worth.
No shadow falls upon a human heart
But leaves eternal imprint of its part
In lessening life's essence for the race;
No ray of truth in thought but finds its place
In piercing some dark nest of ignorance foul,
And breeding truth within a human soul.
Not one, but many shadows make the night;
What myriad rays are needed for the light!

VIII.

Truth, like the universal force, is one.
Not for the keen-eyed intellect alone;
But for the feeling, and the moral sense
The steadfast duty, scorning consequence.
The right is truth, and beauty which appeals
To feeling, with its magic spell reveals
The way of truth, as when the sudden glow
Of summer lightning makes us swiftly know
The path we sought for in the murky night
With careful footing to the left and right.
Emotion and imagination play
The lightning's part along the mental way,
But when the flash is gone sure reason's tread
Must test the ground to which their light has led.
Too often 'tis a by-path where we stray
Far from the truth's direct and upward way.

IX.

Because we fear not hell nor dream of heaven
Shall we pollute our souls with poisonous leaven
Of luscious vice, that grows from sire to son,
Retarding that evolving work begun
When life—whate'er it be—took fleshly shape?
Shall we degenerate to loathsome ape?
Whole families of man have met this doom,
And have been blotted out, to make more room
For those whom nature's law selects as best
To carry on that marvelous bequest
That man shall slowly rise to higher power
Of brain and heart. We cannot know what dower
Of wisdom vast a future race may claim;
We can be builders, with the lofty aim
Of aiding, not retarding, nature's plan,
Strangely foreseen in mythic devil's scan,
When "Ye shall be as gods," he said to man.

X.

There is a beauty in the Christian's death.
In sweet serenity of childlike faith
He falls asleep upon a father's arm,
With simple trust believing that no harm
Can reach him through the strange dark hours of night,
And that the Father's hand can make the light
Spring up from some new sun of life, to shine
In undiscovered realms of bliss divine.

But is this nobler than the death of man,
Religion's orphan, who can only scan
The past and present, but who cannot see
Through the black veil that hides futurity?

No faith nor father offers promise sweet
Of life to come and recompense complete.
He only knows that law shall still prevail,
Nor plea nor pretext anywise avail.
Equal to either fortune, he awaits
The knowledge—or the silence—of death's gates.
He parts from life, the law of life obeyed,
Unknowing, unbelieving,—unafraid.

CHARLES L. MARSH.

CHICAGO, ILLINOIS.

CRITICISMS AND DISCUSSIONS.

REFLECTIONS ON IMMORTALITY.

CHAPTER XI OF HAECKEL'S "THE RIDDLE OF THE UNIVERSE."

"If a man die, shall he live again?" Job, xiv, 14.

A summer night; an open casement, and near by a candle brightly burning, in whose rays a student ponders over volumes of ancient lore.

"I am so beautiful," says the candle-flame; "I drive away the thick gloom and give light and joy to this lone student in his profound studies. Surely I must live forevermore! What rapture, when freed from this gross candlestick, to soar through the realms of space—transformed, immortal!"

Suddenly, through the casement, came a breath of that summer night, and the bright flame was outblown: student, apartment—all wrapped in darkness!

But hark! what weird music on the rising breeze? Ah, the harp, erstwhile silent, has awakened to Æolian strains, and the night is beautiful with melody; while the swelling blast arouses ever louder, wilder and more exultant minstrelsy:

> "Harp of the zephyr, whose least wave o'er
> Thy tender strings stealing, is felt by thee—
> Harp of the whirlwind, whose fearfullest roar
> Can arouse thee to naught but harmony."

"Oh," exclaims the wind-harp's voice," my music, so fitted to move, to thrill and exalt the soul, can never die. When freed from these clogs of wood and iron I shall fly away, forever rejoicing in aspiring song!"

Meantime increased the gale in strength and fury; when, crash! fell casement-walls, crushing harp and harpstrings, and their triumphant notes—where are they?

And now night and storm have passed. The sun, rising into the cloudless blue, lights up a wide landscape, sloping from mountainside, in hills, and vales, and woodlands, and silvery streams—away to the sea, far-gleaming on the horizon's verge; a landscape all glittering with jewels resting motionless on grassblade and petal, or pendant from leaf and plumy tree-top.

Such calm! Such glory of morn, of earth and sky! Stooping to examine minutely a dewdrop, one of the countless millions around me, I hear it say: "Behold, skeptic and materialist, this graceful form! a sphere of light—clear, undimmed by aught of soil or stain, reflecting the infinite heavens, imaging yonder sun—think you that such wondrous and illimitable powers were conferred only for an hour, a day, or a year? Ah, no; these gifts cannot die. I shall live forevermore!"

But soon the sun has risen midway up the eastern sky; a whiff of air has stirred herbage and foliage; the myriads of dewdrops—tiny ambitious children of the swift tempest—where, O, where are they? Exhaled in the fervid sunbeams, shaken upon the ground, mingled with rivulet and river—and they hastening to mingle with that far-gleaming sea!

C. W. KENDALL.

MT. RAINIER, MARYLAND.

THE PROBLEM OF LIFE AFTER DEATH.

WITH REFERENCE TO MR. C. W. KENDALL'S "REFLECTIONS ON IMMORTALITY."

If a light shines in the night and is blown out, shall it ever be lit again or shall it remain extinguished forever? Most assuredly it may be lit again, and certainly it will be if ever it be needed. But the question arises, Would a light lit in the second watch of the night be the same as the light that burned during the first watch? Such was the question which the Buddhist sage Nagasena proposed about 2000 years ago to the Greek King Meleander, called by the Indian people Milindo, as recorded in the Buddhist book, *Milindapañyo*. And the answer was that in a certain sense the light of the second watch is, and in another sense it is not, the same light. It is the same in kind but it is different, as it burns at another hour and is feeding on other material though of the same kind.

The question is asked for the sake of solving the vexed problem

of personality and its continuance beyond death. The Brahmans of those days believed in transmigration of soul, the Buddhists did not. The Buddha had taught his disciples that there is no soul entity which can migrate, for every human being, as everything else, is a compound, is the result of a combination, and it lies in the nature of things that all compounds will be dissolved again. But while there is no transmigration there is rebirth.

That a deed (called *karma*) lives on and has an after-effect was scarcely doubted in India by any one and certainly not by the Buddhists to whom every individual creature was but the effect of former happenings. This is true of every organism, of man, of beasts and of plants, yea of chemical formations as well. Says Professor Huxley in comment on the Buddhist doctrine of karma:

"Everyday experience familiarizes us with the facts which are grouped under the name of heredity. Every one of us bears upon him obvious marks of his parentage, perhaps of remoter relationships. More particularly, the sum of tendencies to act in a certain way, which we call 'character,' is often to be traced through a long series of progenitors and collaterals. So we may justly say that this 'character'—this moral and intellectual essence of a man— does veritably pass over from one fleshly tabernacle to another and does really transmigrate from generation to generation. In the new-born infant, the character of the stock lies latent and the Ego is little more than a bundle of potentialities. But, very early, these become actualities; from childhood to age they manifest themselves in dulness or brightness, weakness or strength, viciousness or uprightness; and with each feature modified by confluence with another character, if by nothing else, the character passes on to its incarnation in new bodies.

"The Indian philosophers called character, as thus defined, 'karma.' It is this karma which passed from life to life and linked them in the chain of transmigrations; and they held that it is modified in each life not merely by confluence of parentage, but by its own acts.

"In the theory of evolution, the tendency of germ to develop according to a certain specific type, e. g., of the kidney-bean seed to grow into a plant having all the characters of *Phaleolus vulgaris* is its 'karma.' It is the 'last inheritor and the last result' of all the conditions that have affected a line of ancestry which goes back for many millions of years to the time when life first appeared on the earth.... The snowdrop is a snowdrop and not an oak, and just

that kind of a snowdrop, because it is the outcome of the karma of an endless series of past existences."

There is a transference of karma and this is accomplished according to natural law. The Buddhist sage is very careful to point out that there is nothing that migrates from a banana rotting in the ground to the new banana growing on the tree sprung from it, but there is a continuous concatenation of effects resulting finally in the rebirth of a new banana. This new banana is the same in kind as the old banana; it is the same in character, and it is by a continuous development the continued life of the old banana. A seed of the old banana has sprouted, has assimilated the surrounding soil and water to its own structure and in the course of its further growth reproduces itself. This is called by the Buddhists rebirth, and they insist that there is no soul entity, no self, no banana thing-in-itself, that passes over from the old banana to the new banana; but there is according to the karma of everything a re-formation of its character, and thus do deeds continue.

This is the basis of the Buddhist idea of justice. Everything good or evil persists and we reap what we sow. The new generation is in a certain sense not the same as the old generation, but in another sense it is the same; it is its continuation and its outgrowth, as much as, but no more than, the grown man is the same as the boy or even as the babe which he was born.

This theory of rebirth is not limited to the physical growth of a man; it extends also to intellectual fields as the same Buddhist philosopher explains. Thus thoughts, as transferred and thereby characteristic traits, intentions, aspirations, sentiments, knowledge, etc., are impressed upon others. Nagasena says: If the teacher recites a stanza and the disciple repeats it, cons it and learns it by heart, there is no particle of any substance, no entity of any kind, no self of the stanza transferred, there is no transmigration taking place, and yet the stanza of the teacher is impressed upon the mind of the disciple, just as a seal is impressed upon the wax, and thus by karma, by the form of activity, the stanza is reborn.

This ancient view of immortality is practically the truth of evolution. We ought not to call it in a negative form immortality, but in a positive description of what actually takes place, continuance of life and indeed a continuance of our most personal forms of life.

The Buddhist philosopher is very explicit in explaining the efficiency of karma. In connection with the allegory of the light he says: Suppose a man arises in the night and causes a lamp to be

lighted; if he dictates a letter and has his scribe take it down, will not the act of writing cease, while the written letter remains? This is to explain the truth about transiency and permanence. The doing of a deed passes, but the effect remains. When the letter is received by the addressee, he reads it and the writer's words are reborn in the addressee's mind. These are simple and very obvious truths, and they are the basis for all our moral aspirations. Our interest in life does not cease at death; our hopes and fears extend beyond the grave and our aspirations continue to live when our bodies meet with decay. And what are we? Are we our bodies or our aspirations? Are we matter or mind?

All religions possess the idea of immortality. They extend to man an expectation or a hope that he will live on in one shape or another, that what he has done will continue to have its effects and has not been done in vain; that his life is not as if it had been writ in water but leaves traces and helps to build up the future, and this hope is not vain. The allegories and notions of the nature of immortality are often gross and erroneous, yea superstitious, but the nucleus of the belief is true and for that reason it will never die.

Professor Haeckel is not thorough-going in the exposition of his monism. He is too negative. He is too much bent on telling people what is wrong in their religious beliefs to see the truth of the old doctrines. He has been carried away in the heat of battle to attack the windmills of superstition and forgets therewith to point out the positive truths of science, of monism, of the actual facts and the lessons implied in facts.

The conception of monism here propounded has been under the suspicion of being a kind of dualism, or at least a compromise with dualism; but it is truly monistic. In fact it is more monistic than the so-called Haeckelian monism, for it explains more and recognizes the significance of human life with its ideals and aspirations. The religious development of mankind is not a mere vagary; it is as much a natural phenomenon as the growth of a tree or the development of human society and all human institutions. From the start of his humanity man has been groping after certain truths to satisfy the cravings of his heart and bring him in tune with the All of life, the cosmos, the constitution of the universe. Our souls are not material things, or substance, or entities. Our souls consist of our wills, our thoughts, our sentiments, and these non-material factors, though not concrete objects, are as important in life, if not

more important, than the materials of which objective reality consists.

To present a true monism which would not overlook the most significant phenomena of existence has been the aim of our life's work, and we feel confident that we have succeeded. We challenge both parties, the old religionists and the new anti-religionists, to point out a flaw in our arguments. This world is a unitary system, its so-called laws of nature are only so many applications of the cosmic order, and the lawdom of the world (its *Gesetzmässigkeit*) implies that science is possible, that all phenomena are at least in theory comprehensible and that all of them can be harmonized in a world-conception free from contradiction—i. e., the ideal of our search for truth in monism.

P. C.

BUDDHIST INFLUENCE ON CHRISTIANITY.

The original German of Carl Clemen's *Primitive Christianity and Its Non-Jewish Sources*[1] appeared at Giessen in 1909, and the present English version is said to be brought down to date. The field covered is so wide that the performance is naturally unequal. While fully appreciating the author's conscientious toil, one could wish that he had sometimes consulted a specialist, particularly as regards Buddhism. His Buddhist criticism is thirty years behind the times. On page 36 he quotes in Kern's translation the famous Asokan Edict which draws up a list of scriptural selections sanctioned by the Emperor. But, worse than this: he also gives us Kern and Weber's attempts to identify the texts. Any Indianist could have told him that Senart, Bühler and Rhys Davids had advanced the interpretation since the time of Seydel and Kern. In Vincent Smith's *Asoka* (Oxford, 1901; 2d ed., 1909) these results are summarized. The first of Asoka's selections was identified in 1904 by an American scholar in *The Light of Dharma* (San Francisco), now reprinted in the *Journal of the Royal Asiatic Society*, April, 1913. As these titles are of fundamental importance for the antiquity of the Buddhist Scriptures and their power to influence the Christian, the use of a thirty-year-old translation is a grave defect.

Indeed the whole Buddhist-Christian problem suffers under Clemen's hands from inadequate treatment. The principal work on

[1] Edinburgh, T. &. T. Clark, 1912.

this subject is no longer one in German, but in English, and Professor Clemen confesses (page 8) that he has never even seen it. He knows it only by a 34-page abstract of 1904. Again and again does he quote the comparisons made by Seydel in 1882, without the aid of the Pāli Canon in its entirety, and ignores the detailed work which has since been done. Not only so, but Clemen fails to grasp the fact that, at the time of Christ, India was one of the four great powers of the earth, and that her most popular religion, Buddhism, was being propagated by missionaries in foreign countries, and its scriptures translated into the vernaculars of the Parthian Empire, the buffer state between Palestine and India. The Parthians who were present at Pentecost could have seen Buddhist texts in Sogdian and Tokharish. India was a maritime power with colonies on islands and continents, and her religious ideas were spread and discussed by merchants and travelers, just as they are to-day. The venerable Benjamin Smith Lyman, who has lived in India and Japan, assures me that this class of men discuss religion, and we know from Josephus that they did so at the beginning of the Christian era.

On page 317 Clemen is again thirty years out of date, in dealing with the Temptations. He quotes Seydel and Van Eysinga, neither of whom had access to the originals, but only to the small fraction of translated texts. It is true that Van Eysinga dates from 1901, but Seydel was confessedly his master, and he made no use of translations which were at that time appearing in Chicago.[2] Even in the second German edition of Clemen's book (1909), these are insufficiently used. Moreover, Clemen quotes the Lalita Vistara where he ought to quote the Classified Collection. So long ago as 1902 I printed the title: "Temptations of Empire and Power to Transmute Matter"; giving the reference to the Classified Collection and even to the German translations of Oldenberg and Windisch. In 1905 the whole comparison was printed at Tokyo; and in *The Monist* for January, 1912 (Clemen dates his new preface: Bonn, September 1, 1912) it was shown that not only these two Temptations had their root-ideas in Buddhism, but also the third: viz., the temptation to commit suicide. The difficulty is that Indianists are not New Testament scholars, and these latter are not Indianists. Only one man on earth is both: viz., J. Estlin Carpenter, principal of Manchester College, Oxford. Consequently a scholar who has spent his life and sacrificed his all in these researches can be ignored by even so careful and conscientious a worker as Clemen, whose footnotes are

[2] *The Open Court*, in scattered numbers of the years 1898-1903.

a forest of international names, and who is manifestly striving his best to do justice to all.

Doubtless his valuable work is much sounder in the more beaten tracks of Mazdaism and Chaldeism, though I observe that the crucial proof of Satan's derivation from Ahriman is overlooked. The fact is that, whereas in the pre-exilic Samuel, Jehovah tempts David to number Israel, in the post-exilic Chronicles it is Satan who does this. (2 Sam. xxiv. 1 and 1 Chron. xxi. 1.) This means that during the Captivity and the Persian period the subject Hebrews were very naturally influenced by their tolerant overlords, and that a former function of Jehovah was now exercised by the Devil, who had been brought among them by their political masters.

On page 359 Clemen says: "There are no grounds for supposing that Anando was (as Edmunds thinks possible) the original of the beloved disciple." This remark refers to the following from my *Buddhist Texts in John* (1906, p. 22): "I am sometimes tempted to regard the Beloved Disciple (so conspicuously absent in the Synoptists) as a Christian imitation of Buddha's Anando. Indeed it is remarkable that both these beloveds were assured by the Masters of attaining heaven here." (Texts quoted.) The grounds, which Clemen denies, are very strong. Here we have Mark and the Logia-Source with no Beloved Disciple and no Penitent Thief, whereas the later Gospels of Luke and John supply us with both. And why? Because the new religion had to compete with one already five centuries old and full of aggressive missionary activity, translating its texts and carving the scenes of its scriptures on temple gates. In India and Ceylon these sculptures could be seen, as well as in the realm of the Bactrian Greek traders who did business with Ephesus and Antioch. The Penitent Brigand was a favorite theme in these sculpures, and so was the Beloved Disciple.

These remarks are made in order that our learned author may improve his next edition by doing full justice to one of the greatest of ancient religions which demonstrably influenced our own. The discussion between Richard Garbe of Tübingen and two American scholars in *The Monist* for 1912 has reopened the whole question; and Clemen's work, which is already quite a mine of information, will be of greater service to the student when brought down to date.

Now that the reviewer has freely dealt with Carl Clemen's limitations, he wishes to say that he has not done it with the intention of fault-finding, and it is only fair that he should acknowledge his own. His defect has been weak German, which he took up only in

his thirties. By reason of this he did not pay proper attention to Clemen's German edition in 1909, or he (the reviewer) would not now be lamenting his deficient recognition in an important work which possibly people will swear by for the next ten years. But we must be patient with the slowness of research. As the writer has elsewhere observed:

> Be patient, man! The star-lore time is slow,
> And like her cycles is the silent flow
> Of all our learning down the centuries:
> Millions of minds must think before we know.

As it is we cannot but be grateful to Clemen for having sifted out so much and given us such an interesting summary of the many loans which Christianity has made from older faiths.

ALBERT J. EDMUNDS.

ENGLISH AS A UNIVERSAL LANGUAGE.

While the editor of *The Monist* was abroad two years ago he attended the Monist Congress and found there a few Americans, among them the late T. B. Wakeman, of Coscob, Conn., Prof. Jacques Loeb, of New York, and Lester F. Ward, the well-known sociologist.

Professor Loeb lectured on the physical world-conception, and pointed out how physical science is on the verge of constructing organisms. The facts which he communicated concerning artificial fertilization and other interferences with the structures of organized life were extremely interesting. Professor Jodl, of Vienna, advocated monism not as is usually done from the standpoint and in behalf of natural science, but from the standpoint of the ethicist and the philosopher. His need of consistent thought had led him to adopt monism, and his arguments appealed strongly to the audience.

It is a striking feature of German congresses that English is very little spoken and lectures are scarcely understood unless they are given in German. The French speaking delegates have a better chance of being understood, and considering these facts we regret to say that there is not yet a good means for people of different languages to communicate with each other. At that time we expressed the view that English is the best fitted medium for international purposes, and with reference to this comment, Mr. Wakeman in a personal letter called attention to the significance of this subject, which he wished to be brought before the public.

He wrote:

"Among the incidents that added to my wisdom and courage was your very interesting conversation at the 'Fahrhaus' on the propriety of an effort to induce all civilized peoples, in addition to their own language and as a completion thereof, to have a revised and practical form of the English language taught in their schools as the universal language of science and humanity, and of general international intercourse. I think you made it clear that this step is demanded by the nature of the language itself as well as by the fact of its very general use now, and its inevitable promise in the future. The fact that you were a German of the Germans by birth, inheritance and scholarship, who did not become acquainted with English until you had reached your middle life, and that your conviction is the result of an impartial examination of the facts and reasons *pro* and *con*, against your early prepossessions, marks you as the proper one to open up a general consideration of the subject. The proper time to do that is certainly the present, when monism is making some general means of communication a practical necessity, which it seems no limited and artificial language can reach."

While on the subject of universal languages it is well to note that in the opinion of many Esperanto and Ido have been superseded by a newer rival called simply "Universal." This is the invention of Dr. H. Molenaar, a Bavarian, and claims to be easier to learn and more international than Esperanto. Since it is supposed to be intelligible to those who can speak only English, we here quote a few sentences from a postal card published for advertising purposes:

"Universal-ling es plus simpl, plus fazil, plus kurt, plus praktik ke tut altr universal-ling-sistem; es komprensibl sin stud a tut kultivet European e Amerikan; hab leplus simpl gramatik imaginabl; son vokabular es komun a mult lingi; es non min fazile parlet ke skribet; es un exelent preparazion pro stud de Latin e de tut altr ling oxidental; es egale bon pro zienz, literatur e komerz; es aprendet in pok hori."

Dr. Molenaar has undertaken two periodicals in the interest of his new language; one, *Universal,* was started in 1907 and two years later he branched out into a more ambitious magazine, *Humanitat,* which the secondary title describes as an *organ pro tut interesi humanitar e internazional.*

Another recent attempt at constructing an international language is the *Interlingua* which flourishes under its director, G. Peano, professor in the University of Turin, and its vicedirector and treasurer. Dr. Prof. G. Pagliero, Via S. Francesco 44, Turin. This

language is made up almost entirely upon Latin roots although it admits some others in its vocabulary. For further explanation we quote from the *Interlingua* circular the following paragraphs.

"Latino es in parte internationale, et in parte mortuo. Scriptore, que adopta toto vocabulario latino, cum grammatica simplice, es intellecto ab lectore que consulta vocabulario latino, sed non intelligibile ad primo visu. Pro scribe in modo subito intelligibile, es necesse vocabulario de latino internationale. Academia judica internationale omni vocabulo latino existente in vocabulario etymologico de anglo. Latino et anglo es duo extremitate, in tempore et spatio, de lingua internationale.

"Vocabulario latino-anglo pote es substituto, sine errore sensibile, per latino-français aut latino-italiano etc. Vocabulo latino, vivo in nostro lingua, es bono. Si vocabulo latino es mortuo, quære æquivalente in dictionario de synonymos. In ipso vocabulario latino-nationale, ad voce nationale, sæpe responde plure synonymo latino et viceversa.

"Academia adopta omni voce internationale, et non scripto in vocabulario latino ad usu de schola, per exemplo: *reale* (ex L. *reale*) *acephalo* (ex Græco), *telegrapho* (ex. G. *tele graph -o*), *artista* ex L. *arte* et G. *-ista*), *algebra* (L. math. ex Arabo), *tabaco* (L. botanico ex Americano), etc."

THE MULTIPLICATION OF PEARS AND PENCE.

We are in receipt of an open letter by Frederick Hovenden which attacks most vigorously the present system of teaching algebra. It contains a passage of interest to both mathematicians and physicists, serving to stimulate thought on a problem which has perhaps not been sufficiently understood.

Mr. Hovenden offers a prize of 500 pounds, a goodly sum, to any one who will perform in public the act of multiplying apples and pears by pence, or any similar trick in which our common school algebras abound. He holds this and similar absurdities up to ridicule and we must say we have rarely seen any practical development of science made sport of with a greater semblance of justice. Our algebra works all right in practical life and yet we wonder whether Mr. Hovenden's challenge will not be taken up by some one who believes in algebra.[1]

[1] We intended to publish a quotation from the original text of Mr. Hovenden's pamphlet, but it has mysteriously disappeared in the ever-yawning

In comment on his severe accusation we wish to say that physical formulas such as the Kepler laws, the laws of gravitation, the laws of motion, etc., employ letters such as *g* for gravity, *t* for time, *d* for distance, etc. But we must bear in mind that these symbols, unlike the letters of algebra, do not stand for the things of which they are abbreviations, but for the number of units of time, distance, etc. The symbol *g* is simply an abbreviation for the number of feet representing the initial velocity of a falling body on earth. In a formula such as $1/2\,gt^2$ we do not multiply time by gravity, which would be nonsense, but we multiply the number of seconds represented by *t* with the number denoting the initial velocity of gravity. This is a big difference, for it would be quite difficult to multiply time by gravity or by mass or any other item which has been abbreviated in the nomenclature of physics by a different letter. The laws of algebra hold good for the formulas of physics, but for all that the physical formulas are quite different from algebra, and have an application of their own.

The science of algebra is an *a priori* construction, and each letter denotes some magnitude of its own which is handled according to the laws of arithmetic, and can be inserted when the conclusion has been made, in which case it will find any magnitude on condition that it remains consistently the same throughout the calculation. It is quite amusing to think that in algebra we are expected to multiply objects such as tables and chairs, or apples and pears, and it would indeed be difficult to comply with the hanky-panky trick in public. Mr. Hovenden's 500 pounds are pretty safe in his pockets if he will pay them only for performing this remarkable feat, but it might have been better for our comprehension of the nature of physics as well as of algebra to offer that same sum for a sensible and clear explanation of the problem which puzzles the vice-president of St. Luke's Lunatic Hospital.

* * *

We sent a copy of these few remarks to Mr. Philip E. B. Jourdain, of Cambridge, England, partly in the hope that he might help us to locate Mr. Hovenden's letter. He makes the following additional comments:

"Hovenden's strictures on the use of symbols in algebra and physics are quite just, and your remarks also seem to me very much to the point. It is very curious that an explanation of Hovenden's

mouth of the editorial waste-paper basket or at the hands of the printer's devil.

difficulty is so rarely given. For this reason, I think the following quotation from De Morgan's *Elements of Algebra* (London, 2d ed., 1837, p. ii) is worth making:

"'How many of the operations of arithmetic can be performed with concrete numbers, and without speaking of more than one sort of 1? *Only addition and subtraction.* Miles can be added to miles, or taken from miles. Multiplication involves a new sort of 1, 2, 3, etc., standing for *repetitions or times,* as they are called. Take 6 miles 5 times. Here are two kinds of units, 1 mile and 1 time. In multiplication, one of the units must be a number of repetitions or times, and to talk of multiplying 6 feet by 3 *feet,* would be absurd.[2] What notion can be formed of 6 feet taken "3 feet" times?

"'But in solving the following question, "If 1 yard cost 5 shillings, how much will 12 yards cost?" do we not multiply the twelve *yards* by the five *shillings*? Certainly not—the process we go through is the following: Since each yard costs five shillings, the buyer must put down 5 shillings as often (as many *times*) as the seller uses a one-yard measure; that is, 5 shillings is taken 12 *times.*

"'In division, we must have the idea either of repetition or of *partition,* that is, of cutting a quantity into a number of equal parts. "Divide 18 miles by 3 *miles,*" means, find out how many *times* 3 miles must be repeated to give 18 miles; but "Divide 18 miles by 3," means, cut 18 miles into three equal parts, and find how many miles are in each part.

"'18 miles divided by 3 *miles* gives 6; meaning, that 3 *miles* must be repeated six *times* to give 18 *miles.*

"'18 *miles* divided by 3 gives 6 *miles*; meaning, that if 18 miles be cut into *three equal parts,* each part is 6 *miles.* The answer in abstract numbers is the same in both cases; 18 divided by 3 gives 6.'

"It might also be mentioned that Mach (*Mechanics,* p. 144) expresses himself accurately about s/t, but, as a rule (cf. p. 269), follows the usual procedure of mathematics and uses less accurate expressions simply for the sake of shortness. The difficulty seems to me to arise partly from the neglect of the use of *proportions* instead of *equations* (cf. Mach, p. 157) as I remarked in my little book *The Nature of Mathematics,* pp. 62-64."

[2] "'In old books the following is sometimes found. "What is £99. 19s. 11¾d. multiplied by £99. 19s. 11¾d.?" The only intelligible meaning of this is as follows: If a stock of money is to be increased at the rate of £99. 19s. 11¾d. for every £1 in it, how much will that be when the stock itself is £99. 19s. 11¾ d.? Let the student answer this.'"

SCHILLER'S PHILOSOPHICAL POETRY.[1]

[Friedrich Schiller's poetry became with his maturer years more and more philosophical, and as the most illustrious child of his muse we have published in April, 1911, his famous hymn "The Ideal and Life" which we hereby wish to complement with some pertinent remarks by one of the foremost Germanists of this country, Prof. Calvin Thomas of Columbia University, New York.—ED.]

The dominant note of Schiller's later poetry is intellectual seriousness; wherefore, if there be those for whom intellectual seriousness is not a quality of poetry at all, for them he has not written.

Of course his verse is self-revelation, without which poetry cannot be; but it is the revelation of a soul dwelling habitually in the upper altitudes of thought and emotion, and always assuming that fellow-mortals who care for poetry at all will be capable of a serious joy in the things of the mind.

One may say that his art as a poet consists not so much in the direct expression of feeling in sensuous and passionate language, as in the transfiguration of thought by means of impassioned imagery. In his poems as elsewhere he is a good deal of a rhetorician, but he is never insincere. His verse came from the heart, only it was the expression of character and convictions rather than of moods and fancies. It seems intended to edify rather than to portray; to impress rather than to delight. Some of it, too, is occupied with ideal sentiments so abstract and sublimated as to possess but languid interest for normally constituted lovers of poetry.

This last observation has in view more particularly the poems he wrote in the year 1795, while still "hugging the shore of philosophy." Take for example "The Veiled Image at Sais," which tells in rather prosaic pentameters of an ardent young truth-seeker who is escorted by an Egyptian hierophant to a veiled statue and told that whoso lifts the veil shall see the Truth. At the same time he is warned that the veil must not be lifted save by the consecrated hand of the priest himself. Moved by a curiosity which can hardly seem anything but laudable,—unless one is prepared to take the side of the sacerdotal humbug,—the young man returns in the night and raises the veil. In the morning he is found pale and uncon-

[1] See the author's *Life and Works of Schiller*, New York, Henry Holt & Company.

scious at the foot of the statue. Soon afterwards he dies, leaving to mankind the message:

"Woe unto him who seeks the Truth through Guilt."

Far more interesting is the poem which was at first called "The Realm of Shades" and later "The Ideal and Life,"—a difficult production, which resembles "The Artists" in its suggestion of a voyage through the imponderable ether. We begin with the blessed gods in Olympus and end with the apotheosis of Hercules; and the intervening stretch is like the vasty realm of the Mothers in "Faust." The poem is intellectual, in the sense that its theme is a concept of the mind, and its structure logical throughout; yet every strophe is surcharged with feeling, and the diction presents a marvelous wealth of imagery. It must be conquered by study before it can yield any great pleasure; but the conquest once made, one finds a noble delight in the gorgeous coloring with which Schiller invests his idealistic rainbow in the clouds. Good critics, favorable to Schiller's genius, regard "The Ideal and Life" as the greatest of his philosophic poems and the most characteristic expression of his nature. He himself felt a sort of reverence for it. "When you receive this letter," he wrote to Humboldt, "put away everything that is profane and read this poem in solemn quiet." And Humboldt replied: "How shall I thank you for the indescribable pleasure that your poem has given me? Since the day on which I received it, it has in the truest sense possessed me; I have read nothing else, have scarcely thought of anything else."

The general drift of the wonderfully pregnant verses is that man attains peace only by renouncing the things of sense and living in the realm of shades, that is, among eternal ideals. Here he is free—like the gods.

Throughout the poem "Beauty" is put for "the Ideal"; and we get a reflex of the philosophic doctrine that only the esthetic faculty can resolve the eternal conflict between the sensuous and the rational man. Life is and must be struggle, that being its very essence; but by taking refuge in the Realm of the Ideal, man anticipates his apotheosis. There he escapes from the tyranny of the flesh and the bondage of nature's law. The misery of struggle and defeat no longer vexes him. The warring forces are reconciled and he sees their conflict under the aspect of eternal beauty. Thus, like the new-born god, Alcides, taking leave of the terrestrial battle-ground, he mounts into heaven, while the nightmare of the earthly life "sinks and sinks and sinks."

All this may seem, at first blush, to attach excessive importance to the attainment of inward peace and harmony,—as if one's private comfort were the greatest thing in life. It *seems* to recommend a quietistic, contemplative life; for how else shall one escape from the actual into the ideal? Nevertheless it would be a great mistake to read into the poem anything like a recommendation of quietism. The ultimate goal is described in terms which suggest now the mythology of Homer, now the Platonic realm of ideals, and again the Christian heaven; but however the blessed existence is imaged, it is always thought of as attainable only through a strenuous grapple with the realities of this life. Thus the essential spirit of the poem is the spirit of energetic, hopeful endeavor. Its doctrine is, to quote the words of Kuno Francke, that "only through work are we delivered from the slavery of the senses"; that "the very trials and sufferings of mankind bring out its divine nature and insure its ultimate transition to an existence of ideal harmony and beauty."[2]

The doctrine, in its essence, was dear to Goethe, as well as to Schiller, and takes us into the holy-of-holies of their joint philosophy. What else did Goethe mean by his oft-reiterated preachment of renunciation, and by his well-known verses about "weaning oneself from the half and living resolutely in the whole, the good and the beautiful"? In his excellent book upon Diderot Mr. John Morley speaks somewhere of "that affectation of culture with which the great Goethe infected part of the world." Let it not be forgotten, however, in our latter-day contempt of culture, that the Weimar poets were great workers, and also, in their way, great fighters. They did not turn their attention—at least not directly—to the crushing of the Infamous, nor to any battle against social or political wrong. They fought rather for sanity, for good art, for philosophy; for those things which go to enrich and broaden the life of the individual. It was a good fight,—the best which, at their time, with their gifts, they could possibly have engaged in.

Schiller's fervid verses, recommending an escape from the bondage of sense to the free realm of the mind, correspond of course to nothing that is humanly feasible. The shackles of the flesh are upon us and there is no way to get rid of them. It is only an ideal, a poet's dream. Nevertheless the subject has a practical aspect which is definable in plain prose. It is found in the following passage from Goethe:

"We put one passion in place of another; employments, dilet-

[2] *Social Forces in German Literature*, p. 376.

tantisms, amusements, hobbies,—we try them all through to the end only to cry out at last that all is vanity. No one is horrified at this false, this blasphemous saying; indeed it is thought to be wise and irrefutable. But there are a few persons who, anticipating such intolerable feelings, in order to avoid all partial resignations, resign themselves universally once for all. Such persons convince themselves with regard to the eternal, necessary, law-governed order of things, and seek to acquire ideas which are indestructible and are only confirmed by the contemplation of that which is transient."[2]

CALVIN THOMAS.

COLUMBIA UNIVERSITY, NEW YORK.

PROBLEMS OF PURE FORM.

AN EDITORIAL DISCUSSION WITH M. LUCIEN ARRÉAT AND G. A. BLACK.

The Editor has received two comments on his exposition of the nature of mathematics. One comes from M. Lucien Arréat, who objects to the idea that the triangle is a product of three lines on the ground that it consists of a section of the plane bordered by three lines.

We translate from M. Arréat's letter: "Is it quite correct to consider *lines* as *elements* which produce the triangle? By construction the lines bound a portion of space, but they do not produce this portion; they only define the figure conceived or indicate directions. Lines do not seem to me to be real in any different sense than the figure which they render visible to our eyes. They do not seem to me to be a quantity while the figure which they ideally define would be a quality. These remarks do not however in the least prevent us from studying the triangle as a type of form."

Lines have qualities such as direction. The line consists of length without breadth or thickness, and lines can be measured quantitatively according to their length. When three or more lines intersect they produce geometrical figures, and these geometrical figures possess new qualities not to be derived from their elements which in this case are mathematical lines.

What M. Arréat calls the triangle is really the contents of the triangle, viz., its area enclosed by the sides. The character of the triangle consists of the direction and the length of its three sides

[2] *Dichtung und Wahrheit*, Bk. XVI.

with all the relations they imply. The triangle cuts out of the plane an area of a definite shape, and it possesses a great number of qualities determined by the interrelation of the sides, such as definite angles and perpendiculars, and it has a definite inscribed and a circumscribed circle, besides ascribed circles, etc., the sides extending beyond the three corners into infinity.

The other comment is offered by Mr. George Ashton Black who writes as follows:

"A passage on page 9 of your pamphlet entitled *The Philosophy of Form* moves me to send you the following remark:

"The assemblage of cognitions properly named and ordered by you

plane
straight line —
parallel lines =

is necessary and sufficient to construct mathematically Kant's metaphysical theory of cognition generally, meaning his enumeration of the different successive steps in the process of making any object by degrees completely known according to a constant rule. Witness

$$\text{ideal} \begin{cases} \text{intuition} & \text{synthesis} \\ \text{concept} & — \text{ analysis} \\ \text{idea} & = \text{dialectic} \end{cases} \text{method}$$

where the same cognitions, considered from two different points of view, are regarded on the one hand as determinations of a known object; on the other as acts of a knowing subject.

"Accordingly the classic symbol of equivalence (=) as a fact or thing done is the norm or prototype not merely of mathematical science, but even of any science whatever; and the actual production of it by degrees is the simplest possible real use and practical application of the scientific method complete."

Mr. Black's proposition that the plane, the straight line and parallel lines are all the essentials needed for constructing the metaphysical aspects of the Kantian world-conception will scarcely be contradicted if we agree on the term metaphysical. It is interesting to see that in other realms of purely formal thought, especially in logic, the Euclidean character of space is assumed to hold good, and is more closely connected with the foundation of logic than may appear at first sight. Note that the logical figures are all in the shape of mathematical constructions in a plane. The figures of logical reasoning which serve as arguments are circles or squares illus-

trating the relations of genera and species, the former enclosing the latter and explaining in a visible shape their interrelations and the deductions made therefrom. All these arguments presuppose that lines can be made to return to themselves; they are based on the condition that lines may lie in one and the same plane and may constitute figures bound up in definite limits. They presuppose a space not necessarily Euclidean but of a continuity which does not permit the contents to skip out into a third dimension. It is true that the logical diagrams are mere illustrations, not proofs, but if illustrations do not hold good, we have no ground for classifying objects or making any generalization. The idea of form is at the bottom of all thinking, and the assumption of the possibility of a sameness of forms alone justifies us in speaking of "*All A*" and drawing the conclusion that if all A's are B then every single A is B. P. C.

CURRENT PERIODICALS.

In *Mind* for April, S. Alexander continues his paper on "Collective Willing and Truth." J. S. Mackenzie, in a paper entitled "A Sketch of a Philosophy of Order," advocates, "in a brief and somewhat tentative fashion, a point of view that has at least proved helpful to myself in the effort to understand these apparently simple but in reality most difficult problems"—the nature of truth and error and of relations. "It has been my endeavor," he says in conclusion, "to exhibit certain fundamental conceptions as being involved even in the simplest facts of experience; and to show that reflection on them leads us gradually to the recognition of a certain ideal order, which is at least the foundation of our moral aspirations, and may perhaps serve as a basis for an idealistic or spiritual interpretation of the universe. My contention is that there is nothing even in sense which does not already imply something of the nature of an ordered universe. Such an idealism does not seem to be in any way opposed to what is commonly called realism; and it seems to me that we may find in this method of treatment a possible conciliation between views that are usually regarded as antagonistic." The Rev. Oliver Quick has an article on "Bergson's *Creative Evolution* and the Individual." Howard V. Knox writes an appreciation of "William James and his Philosophy," and concludes: "After all, James might well be content to rest his title to fame on his having translated the question 'What makes knowledge possible?' into

the question 'What makes knowledge credible, and conduct possible?' That is what in the history of philosophy will be known as James's Answer to Kant; and there are those who believe that it will rank as more epoch-making than Kant's irrelevant Answer to Hume. In a word, to James belongs the glory of having first divined the Secret of the Plain Man, and ministered to his desire for a knowledge that is relevant to action and to life." In the "Discussions," F. C. S. Schiller replies to his reviewer R. F. A. Hoernlé, L. S. Stebbing replies to his critic F. C. S. Schiller, and G. R. F. Ross and C. H. Rieber have some critical remarks on a logical article by C. E. Hicks in *Mind* for 1912 on Euler's circles and inversion. A short note at the end by C. D. Broad on Zeno's puzzle of Achilles and the Tortoise is interesting since "it is important, even at this time of day, to settle the controversy finally, because it and Zeno's other paradoxes have become the happy hunting-ground of Bergsonians and like contemners of the human intellect." Russell's version of the puzzle in his *Principles of Mathematics* is that the supporters of the Achilles paradox are trying to prove that the course of the tortoise can never be a proper part of that of Achilles because the construction shows that each has the same number of points; while an infinite class and a proper part of itself can have the same number of terms (Cantor and Dedekind). But Broad thinks that the difficulty which many intelligent persons feel lies in the supporters' advocacy of the plausible but false proposition that "what is beyond every one of an infinite series of points must be infinitely beyond the first point of the series."

* * *

In the *Revue de Métaphysique et de Morale* for March, Gustave Belot begins his article on the idea of God and atheism from the critical and social points of view by announcing that his thesis would have reduced him to penury a hundred years ago; it would have brought him to the Bastille two hundred years ago; and would, perhaps, have brought him to the stake 300 or 350 years ago. And yet his thesis is not very subversive: his object is to show that the fear of atheism is chimerical. "Every new affirmation of God presupposes some provisory and relative atheism. The fear of atheism is perhaps the most profound atheism." Albert Rivaud has a long and detailed article on Paul Tannery, historian of ancient science. Tannery undertook to study in a general manner the history of ancient science; and pursued simultaneously four series of distinct but connected researches: on the history of mathematics and their

applications, on the history of astronomy and physics, and on ancient metrology. Death interrupted him just when he was beginning the history of ancient medicine. It is interesting to see that Tannery maintained in *Pour l'Histoire de la Science Hellène,* Paris, 1887, pp. 249, 250, 258, that the well-known paradoxes of Zeno are not sophisms, but are clear and irrefutable arguments against Pythagoreanism. Léon Robin maintains that Plato was not, as he is too often represented, one of the most brilliant legislators of the country of Utopia, but a philosophical and scientific social reformer. Louis Couturat points out that the logical problem raised by Ginzberg in the *Revue* for January has been long resolved by logisticians. Couturat also has a long paper on logistics and intuition in which he points out the error of people like Henri Poincaré and Pierre Boutroux in a way that may be summed up: "The error of the adversaries of logistics arises from the fact that they oppose logic to discovery." Cf. *The Monist* for October, 1912. Léon Brunschvicg discusses the practical question of the organization of the republic according to the works of Henri Chardon on administrative reform.

In the *Revue* for May, Pierre Boutroux has an article on the object and method of mathematical analysis, which forms three chapters of a forthcoming work. These three chapters are on the origins and rôle of algebra, the progress of algebraical synthesis, and analysis. G. Gastinel has a long and critical article on esthetics and sociology, in which he takes as text the *Introduction à l'Esthétique* of Charles Lalo. François d'Hautefeuille, in a paper on the inner life, which is a sequel to a previous paper whose object it was to show the insufficiency of the sociological conception of morals—which rises from inaptitude to place oneself at the point of view of the inner life—, tries to penetrate the importance of this life and understand its nature and the close union of its domain to that of morals. A. Mamelet contributes the fourth and last of his articles on the philosophy of Georg Simmel. Finally, G. Cantecor discusses the question of suicide for the purpose of comparing religious and lay morals.

* * *

In *"Scientia"* (*Rivista di Scienza*) for May, the first article is by Bertrand Russell "On the Notion of Cause." The law of causality, he says, is—at least as usually stated by philosophers—false and is not employed in science. Indeed, "the word 'cause' is so inextricably bound up with misleading associations as to make its complete extrusion from the philosophical vocabulary desirable.

....The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm." Then there follows a most amusing criticism of the definitions of terms relating to the subject in Baldwin's *Dictionary*. Scientific laws, instead of stating that one event A is always followed by another event B, state functional relations between certain events at certain times and other events at earlier or later times or at the same time. In the case of a system of gravitating particles, "certain differential equations can be found, which hold at every instant for every particle of the system, and which, given the configuration and velocities at one instant, or the configurations at two instants, render the configuration at any other earlier or later instant theoretically calculable. That is to say, the configuration at any instant is a function of that instant and the configurations at two given instants. This statement holds throughout physics, and not only in the special case of gravitation. But there is nothing that could be properly called 'cause' and nothing that could be properly called 'effect' in such a system." On this point, we may refer to Russell's *Principles of Mathematics*, Cambridge, 1903, pages 477—479. The "law of causality" seems to be capable of translation by the principle: "There is a constant relation between the state of the universe at any instant and the rate of change in the rate at which any part of the universe is changing at that instant, and this relation is many-one, i. e., such that the rate of change in the rate of change is determinate when the state of the universe is given." This principle cannot be considered as *a priori*. Calling the above certain events at certain times "determinants," the author sums up his further results as follows: "We found that a system with one set of determinants may very likely have other sets of a quite different kind, that, for example, a mechanically determined system may also be teleologically or volitionally determined. Finally we considered the problem of free will: here we found that the reasons for supposing volitions to be determined are strong but not conclusive, and we decided that even if volitions are mechanically determined, that is no reason for denying freedom in the sense revealed by introspection, or for supposing that mechanical events are not determined by volitions. The problem of free will *versus* determinism is therefore, if we were right, mainly illusory, but in part not yet capable of being decisively solved."

Emmanuel de Martonne points out that the climate has at least as

much effect as the sub-soil in putting the soil into that relief which is usually explained geologically. Frederick Soddy, in an article on "The Periodic Law from the Standpoint of Radioactivity," gives an interesting account of how, in 1913, and principally as a consequence of the work of A. S. Russell, G. von Hevesy, K. Fajano, Soddy himself, and A. Fleck, a great generalization has been made with regard to the position in the periodic classification occupied by the 34 radioelements now recognized. This advance sheds a flood of new light on the nature of the periodic law and already more than half answers the riddle underlying that law. The generalization in question is: All members occupying the same place in the Periodic Table are non-separable from one another by chemical methods, and are chemically identical with one another, though their atomic weights vary over several units. Such groups of non-separable elements could not be separately recognized unless they were actually in the process of change the one into the other. A. Prenant gives an account of the physical, as opposed to the vitalistic, explanations of cell-division (mitosis), and concludes that every one of these explanations leave something to be desired. Franz Oppenheimer gives a criticism of Marx's theory of plus value. G. Cardinali, in an essay on the repercussions of imperialism on the inner life of Rome, points out the one-sidedness of historians, and tries to make it easier for one to get a clear view of the essential values and characteristics of the period of the Roman Empire. V. Cornetz replies to some points in an article by H. Piéron on orientation with ants. Michele Gortani gives an account of recent progress in geodynamics. Reviews, etc. fill up the rest of the number. ϕ

CORRESPONDENCE.

DISCUSSION BY THE FRENCH "PLASMOGENISTS" ON THE ORIGIN OF LIFE.

> In the field of spontaneous generation, we have reopened once for all high roads across which backward, retrogressive minds had raised barricades declared by them insurmountable!
>
> Albert and Alexander Mary.

When in the year 1883, in his monthly illustrated review, *L'Astronomie*, Camille Flammarion replied to Mr. Faye concerning the grand problem of the existence of multitudinous inhabited worlds in the cosmos, he affirmed that all the sidereal spheres passed through

a period of nebular life, and that on cooling they reached a phase of organic genesis and evolution followed by an ultimate era of decrepitude and death by glaciation. In venturing into such a generalization, Flammarion committed an error almost as serious as that made by his opponent when he affirmed that organic life was a special privilege granted by God to this planet, a phenomenon unique in its kind, whose recurrence was practically impossible upon other worlds!

It should have been guessed long ago by scientists that all the shining sidereal bodies to be seen with the naked eye or the telescope —the planets of our system excepted—are bodies which, owing to their enormous sizes, produce and radiate considerable pressure-heat with which they can swallow an ever-growing quantity of cosmic materials. Far from cooling and dying in the future as stated gratuitously by Mr. Flammarion and others, our sun is doomed to increase in size, absorbing its planets one by one, together with an always larger quantity of cosmical dusts; and at the same time to grow warmer and warmer, more and more resplendent. All self-luminous sidereal bodies in the sky, all those stars whose surface is a molten, igneous, radiating furnace, will keep their heat for a long time at practically the same thermic degree as at present, and will afterwards increase in pressure-heat more or less rapidly. As the pressure of the surrounding ether upon their surfaces cannot produce motion, it produces pressure-heat. The ether-pressure upon a sidereal body concentrates itself upon spherical areas constantly diminishing in size from its surface to its center. If the internal pressure-heat of a sidereal sphere was exactly proportional to the pressures supported, it would be quite tremendous at the center of big spheres like our sun. But such pressure-heat always spreads itself into the whole of the internal mass as it is produced, so that there is always a certain equality in the temperature of the whole mass of the big, molten sidereal bodies.

This being granted, it is easy to realize that there are no dead suns, as Professor Bickerton admits. All dead sidereal bodies are too small to be suns. Such is the case with Mars, the Earth, Venus, Mercury. It may be thought that our own planet has practically reached its equilibrium in temperature, that the pressure-heat it radiates will now remain unaltered. Recent observation has shown beyond doubt that Jupiter and Saturn must be placed among the self-luminous stars. When seen with the telescope, they look indeed like little suns. It is now quite certain that their molten surfaces

are and will remain always blazing furnaces, by far too hot to bring forth living beings.

If, contrary to accepted theories, the sidereal spheres, when big enough, are destined to grow warmer and warmer, the geological strata of the earth-crust and their fossils show us sufficiently that our planet has grown colder and colder since the primordial ages. At present, scientists generally admit the hypothesis of a vast primordial ocean which during long ages enveloped the whole surface of the spheroid with its thick liquid mantle. As soon as the temperature of the oceanic waters had fallen to the thermic degree at which organic life could arise, a spontaneous genesis of rudimentary living beings took place everywhere in its bosom, owing to the contribution of air, water, salts dissolved into water, the ooze of the marine abysses and, of course, imponderable ether. All the ancient cosmogonies of the Orient seem to have had a correct idea of such a phenomenon. They considered water as the medium into which living beings began, the element of which they are made; they worshiped it as the female goddess over which hovered the spirit, the creative wind, the male god, the active principle: ether, air, fire and light.

In the so-called "epoch-making" address he delivered last year in Dundee, Professor E. A. Schafer pointed out that there was no valid reason to suppose that life had appeared on the surface of our planet at any single period of its past history, owing to a special concurrence of favorable circumstances. If indeed, at a certain moment of our planet's existence, so-called living substance could spring up from inorganic matter, is it reasonable to affirm that spontaneous generation cannot take place again and again, in the present and future life of the earth? If the president of the British Association is still unable to tell us exactly when and where organic life made its appearance upon our globe, we can affirm to-day without hesitation that life springs up by itself when ether and ponderable matter combine, and that thousands of years are not required for the formation of a low form of living beings with a calcareous coat or simply of structureless naked monera, as Prof. E. A. Schäfer seems to believe. No doubt he does not know that lately microscopical observation has shown that in our times the phenomenon of spontaneous generation is still constantly occurring, not only in oceanic waters from the inorganic waste which owing to its specific weight falls into the abysmal depths, but in the mud of putrid waters as a structureless reticulum which divides itself and reunites

at will. We may say here that we do not agree at all with Professor Schäfer when he shows a marked preference for Pasteur's experiments on spontaneous generation over those of Bastian. If Professor Schäfer is convinced of the accuracy of Pasteur's results in his experiments with sterilized liquids, we personally are fully convinced that the conclusions drawn by Pasteur from his experiments were erroneous. But Professor Schäfer himself recognizes that previously to Pasteur many scientists believed in the existence of spontaneous generation. Pasteur came and at once the minds of the scientists found themselves magically sterilized. On the other hand it is clear that the solutions contained in Doctor Bastian's sealed vessels are perfectly sterilized by temperatures as high as 110° C. to 130° C. and upwards. It is absolutely impossible for the so-called organic "germs" observed afterwards by Dr. Bastian in his tubes to have resisted such high temperatures. Again Professor Schäfer commits the mistake of believing that Bastian's organisms, born *de novo*, are highly differentiated organisms. Has not the recent synthesis of Koch's bacillus by the Mary Brothers shown that the so-called microbes are only groups of micellæ with a definite general morphology?

All those who want to know the latest marvels of spontaneous generation should read the admirable works by Albert and Alexander Mary on transformism and synthetic biology.[1] They are no doubt the best of their kind. Quite similarly to Stephane Leduc, whose "pseudophytes" are now well known all over the world, Messrs. A. and A. Mary in their turn, having thrown salt-granules or salt-dusts into salt-solutions of various kinds, succeeded in bringing to life pseudo-organisms showing all the phenomena to be seen in nature. Thus they have added a new and most interesting chapter to plasmogeny, the science of protoplasmic genesis, which though still in its childhood, is already pretty well grown. In a recent pamphlet,[2] Prof. Alfonso Herrera, of Mexico, who laid the foundations of this new science, has included all the sciences under the term plasmogeny. For him, the word is synonymous with natural philosophy.

Destroying all the artificial classifications established so patiently by learned Latinists or Hellenists, breaking up one by one the thin walls of the numerous scientific cells into which the "doctors" were pleased to confine themselves, the logic of accomplished facts at last compels many scientists to recognize that there exists no sharp line

[1] Paris. Jules Rousset, publisher, 12 Rue Monsieur le Prince.

[2] *A ciencia nueva, la plasmogenia.*

between the various branches of science, that all departments of human knowledge are bound with one another, that some day in the future they will unite logically into a single whole because the cosmos itself is a single whole, composed of units made of a unique substance, though infinitely varied in qualities and properties. At present it appears clearly to everybody that so-called "dead matter" cannot be considered as chemically distinct from "living substance." It is well known to-day that the minerals feel, eat, grow, decay and die in the same way as animals. Have not Messrs. Mary compared the contractions of fresh-water amebas to the movements of fuchsine drops thrown into potassium silicate? Have they not recognized recently that the precipitates obtained from many chemical reactions have already a colloid or organic structure? When studied with a microscope, such precipitates show themselves to be composed of multitudinous micellæ, either spheroid or ovoid, whose bulk and shape are similar to those of the micellæ of which adult protoplasm is composed. It is very interesting to note that Messrs. Mary admit that these new molecular structures result from atoms of oxygen, hydrogen, and very likely of ether aggregating with the atoms of the insoluble salt.[3] This is indeed an inference of capital import; it opens new horizons in the almost virgin regions of atomistic chemistry. It was known long ago that in certain particular cases, a mineral can act as an ordinary living organism. When the electric current passes between two platinum electrodes plunged into liquid water, microscopic granulations are formed. Such granulations are fermenting agents greatly resembling fermenting bacteria (colloidal platinum). Has not Charles Edward Guillaume himself remarked that metals may show well-marked evidences of life from birth to death, of sensibility, will, youth, maturity and decay? Has not Leduc affirmed that a common stone, when touched by his finger, responded to the contact with a slight expansion? But is not the neo-dynamist school itself able to prove that a ponderable body, gravitating freely towards the earth, is not passive under the pressures of the ethereal atoms which surround it? It is opposing to these pressures its inertia, which is already an active force. It tends to recover its balance of its own accord when its mass opens its way through the warmest and most expanded ether, which is less energetic in its repulsions.

If Professor Schäfer's address seemed so revolutionary when he declared that the abyss separating the inorganic from the organic

[3] *La Terapeutica Moderna.*

world is filled, is it not because the intellectual world in England is in general insufficiently aware of the intellectual and philosophical movement on the Continent, in the present day? It is conceivable that our descendants in two or three generations will be very much amused to learn that in the year 1912 all the press of London was stirred up for a fortnight because a renowned professor solemnly declared from the rostrum that the ameboid movements of the protista were similar to the movements of oil-drops, of mercury-drops, of the corpuscles of the blood, and of our muscles, when contracting. Yet, is it not sufficient for us to go to the Kensington Museum and examine attentively the minerals of all kinds exposed there to become immediately convinced that the inorganic world has already its rudimentary life, though infinitely diversified as it is in the vegetable and animal kingdoms?

The hypothesis of the rudimentary life of atoms once admitted. we are then enabled to go far beyond Professor Schäfer's own conclusions. We can admit, for instance, that the units constituting the so-called "simple bodies" being homogeneous both in force and volume, are vibrating in unison, that in their various states, they may have already as a vague sentiment, a remote consciousness of the unity of the material mass into which they are included. Should we not see in the chemical molecule a first degree of psychic unity. something as an embryonic conscience? Are not the water-molecule. the air-molecule, organisms—rudimentary cells perhaps, which can hold comparison with protoplasmic cells? And the crystals, what are they? Should we insist upon the analogies between crystalloids and colloids so thoroughly studied by Doctor Bastian? Are not diamond, quartz, precious metals the results of atomic transmutations which take place in the organic molecule?

In the above-mentioned pamphlet, Professor Herrera writes that he considered ether as the primordial protoplasm. Indeed, it is very reasonable to admit this wonderful imponderable substance as the leaven which gives birth to Herrera's silicate cells, Mary's pseudophytes, Burke's radiobes, Harting's corpuscles, Naegeli's colloidal platinum, Bastian's heterogenetic micro-organisms. It is ether which encloses itself in Huxley's bathybius, Mary's protameba, Haeckel's moners, Bechamp's mycrozyms, in every kind of living substance, either albuminous or not. It is ether which constitutes the animated, conscious, sensitive, active centers of all our cells and tissues. It is such subtle "spirit" which is embodied in Haeckel's cell-souls, Clemence Royer's "vitaliferous etheroids." Act-

ing as a thinking substance in the process of organic life, the fluid, elastic, plastic ether will reconcile at last materialism and spiritualism on the neutral ground of substantialism. With such ever living, acting and reacting substance, we return to the marvelous conception of the unity of force, substance and mind which the Ionian dynamists had already established more than two thousand years ago!

ARISTIDES PRATELLE.

PARIS, FRANCE.

MAGIC SQUARES MADE WITH PRIME NUMBERS TO HAVE THE LOWEST POSSIBLE SUMMATIONS.

In making magic squares of all orders with prime numbers it is evident that the sum of the series used must be evenly divisible by n; also, that the quotient must be even when n is even and odd when n is odd.

The number 2 is not used in the construction of prime magics, for, being an even number, it has no analogue among the other primes, which are all odd numbers. In seeking for a series of prime numbers suitable for making magic squares *with the lowest possible summations,* if the first n^2 primes will fill the requirements above stated, they will naturally constitute such a series. If, however, the division leaves a remainder $(=r)$, then one or more substitutions must be made among the higher prime numbers so as to increase the total by an amount equal to $n-r$ or $2n-r$ etc., always taking care to secure the smallest increase possible.

Series of prime numbers theoretically suitable for all squares up to and including that of the 12th order showing the lowest possible summations, are given in the following pages, and it is interesting to note that with the exception of squares of the 3d and 4th orders, these predetermined series of prime numbers have all been arranged in magic formation by various experts.

SQUARE OF THE THIRD ORDER.

The sum of the first nine prime numbers 1 to 23 inclusive is 99, which divided by 3 gives 33 as the quotient.

This sum is therefore theoretically suitable, but it can be demonstrated that 111 is the lowest possible summation for a

square of this order made with primes, and the required s
as follows:

1 — 7 — 13 — 31 — 37 — 43 — 61 — 67 — 73

67	1	43
13	37	61
31	73	7

Fig. 1.

By arranging these numbers in accordance with the sing
that is applicable to this order, the square shown in Fig. 1
duced, which was first made by Mr. Henry E. Dudeney.

SQUARE OF THE FOURTH ORDER.

The sum of the first sixteen prime numbers 1 to 53 in
is 380, which is evenly divisible by 4, but the quotient (95)
an odd number, makes the series inadmissible. The lowes

3	71	5	23
53	11	37	1
17	13	41	31
29	7	19	47

Fig. 2.

mation for this square that is known to the writers is 10
Fig. 2), the series for which is made by substituting 71 for 4

NUMBERS OF ORIGINAL SERIES OMITTED	NEW NUMBERS ADDED	TOTALS OF NEW SERIES	SUMMATIONS
47	59	392	98
53	73	400	100
41	61	400	100
{47} {53}	{59} {61}	400	100
47	67	400	100
43	71	408	102

raising the total of the series to 408. This square was mad
pendently by Mr. Ernest Bergholt and Mr. C. D. Shuldham,
ming, New Jersey. There are at least five other series whic

lower totals than 408 and which are theoretically suitable, but it is stated by competent mathematicians that 102 is the lowest possible summation of a square of this order made of prime numbers. These five series are, however, given below together with the one used in the square wherein S = 102, the departure from original series 1 to 53 inclusive being shown.

SQUARE OF THE FIFTH ORDER.

The sum of the first twenty-five prime numbers, 1 to 97 inclusive, is 1059 which is inadmissible. The twenty-fifth prime (97) must therefore be changed to 103, raising the total of the series to

13	61	103	31	5
71	1	17	83	41
23	79	37	7	67
47	29	53	73	11
59	43	3	19	89

Fig. 3.

1065, the fifth part of which is 213. The difficult problem of arranging this series in magic formation was solved by Mr. H. A. Sayles, Schenectady, N. Y., as shown in Fig. 3.

SQUARES OF THE SIXTH ORDER.

The sum of the first thirty-six primes, 1 to 151 inclusive, is 2426 which is inadmissible. By changing the thirty-sixth prime (151) to 173 the total of the series is raised to 2448, which gives

71	19	61	137	79	41
97	59	149	13	37	53
31	131	3	113	23	107
89	67	5	101	139	7
11	103	173	1	47	73
109	29	17	43	83	127

Fig. 4.

127	3	47	23	53	149
83	43	137	73	5	67
19	89	29	61	173	37
97	31	79	107	53	41
71	103	7	13	101	113
11	139	109	131	17	1

Fig. 5.

the quotient 408 when divided by 6. The arrangement of this series of primes in magic order was accomplished independently by Mr.

C. D. Shuldham and Mr. J. N. Muncey, Jesup, Iowa, and their different squares are given respectively in Figs. 4 and 5.

SQUARES OF THE SEVENTH ORDER

The sum of the first forty-nine primes 1 to 227 inclusive is 4887 which is not evenly divisible by 7. By substituting 233 for

139	211	43	83	149	13	61
197	1	19	199	79	157	47
173	181	67	41	71	163	3
37	7	151	89	127	179	109
113	31	131	223	137	11	53
17	167	97	5	107	73	233
23	101	191	59	29	103	193

Fig. 6.

223	3	197	61	11	13	191
79	43	41	233	163	31	109
71	193	53	113	59	137	73
19	179	7	97	149	67	181
139	47	173	167	89	83	1
151	131	101	23	29	157	107
17	103	127	5	199	211	37

Fig. 7.

227 the total of the series is raised to 4893, the seventh part of which is 699.

Messrs. C. D. Shuldham and J. N. Muncey succeeded independently in making different magic arrangements of this series as given respectively in Figs. 6 and 7.

SQUARES OF THE EIGHTH ORDER.

The sum of the first sixty-four prime numbers, 1 to 311 inclusive, is 8892 which is not evenly divisible by eight, but by

271	3	7	11	181	251	83	307
263	43	283	79	31	163	29	223
173	131	67	109	101	37	269	227
179	61	229	197	73	71	167	137
23	211	149	157	151	107	257	53
97	233	199	239	5	191	103	47
89	293	127	41	241	17	193	113
19	139	53	281	331	277	13	1

Fig. 8.

changing 311 to 331, the total of the series is raised to 8912, the eighth part of which is 1114. The magic square shown in Fig. 8 was made from the above series by Mr. J. N. Muncey. Mr. C. D. Shuldham has likewise made a square of this order by using a series

179	149	233	5	157	103	47	241
73	137	227	191	61	23	173	229
181	19	7	223	269	199	89	127
37	151	257	97	31	277	163	101
113	197	43	79	263	29	283	107
271	109	13	211	3	281	167	59
193	311	83	1	17	131	139	239
67	41	251	307	313	71	53	11

Fig. 9.

in which 313 is substituted for 293—which also has a total of 8912. These two squares both showing the lowest possible summation of 1114, are given respectively in Figs. 8 and 9.

SQUARES OF THE NINTH ORDER.

The first eighty-one primes, 1 to 409 inclusive, have a total of 15115. To raise this total to the lowest number evenly divisible by 9,

409	389	73	17	383	11	19	13	367
311	67	5	137	43	331	397	31	359
103	241	53	347	139	227	37	283	251
307	149	233	167	337	127	101	109	151
29	263	349	47	197	401	113	211	71
193	61	239	269	173	179	317	191	59
199	157	277	89	271	41	293	97	257
107	353	79	229	131	83	223	313	163
23	1	373	379	7	281	181	439	3

Fig. 10.

the last number of the series (419) must be changed to 433, th making the total 15129, the ninth part of which is 1681. Magic squa showing this lowest possible summation were made by Messrs.

281	181	37	227	271	103	307	233	41
13	293	383	19	241	7	73	263	383
101	137	3	379	47	337	53	373	251
397	5	71	67	353	277	331	149	31
61	409	163	229	127	179	433	1	79
367	59	191	269	347	131	17	193	107
97	23	311	151	157	89	317	313	223
197	173	283	257	109	199	139	113	211
167	401	239	83	29	359	11	43	349

Fig. 11.

N. Muncey and C. D. Shuldham and are given respectively in Fi 10 and 11.

SQUARE OF THE TENTH ORDER.

The first one hundred primes, 1 to 541 inclusive, sum 24132. make a total that is evenly divisible by 10 the last number of

1	3	431	503	17	509	13	443	467	29
409	67	307	89	47	457	43	499	37	461
79	379	83	397	37	367	211	107	347	349
181	569	163	157	167	317	139	137	227	359
277	179	271	193	199	197	401	331	241	127
283	281	191	269	263	257	233	251	149	239
173	293	53	311	313	131	337	223	353	229
419	151	389	59	383	19	487	373	23	113
71	421	7	433	439	61	449	41	463	31
523	73	521	5	491	101	103	11	109	479

Fig. 12.

series (541) must be changed to 569 thus increasing the total to 24160. A magic square showing the lowest possible summation of 2416 was made with the above series by Mr. J. N. Muncey as reproduced in Fig. 12.

SQUARE OF THE ELEVENTH ORDER.

The sum of the first 121 primes, 1 to 661 inclusive, is 36887, which is not evenly divisible by 11. By substituting 677 for 659, the total is raised to 36905, the seventh part of which is 3355. This

1	613	3	587	61	631	107	643	19	653	37
607	73	71	223	619	59	569	47	503	43	541
461	467	83	347	137	499	53	509	149	127	523
457	181	593	173	179	167	491	157	409	151	397
211	353	197	487	227	431	239	419	271	269	251
331	199	337	307	283	293	421	277	389	379	139
317	463	443	67	349	229	373	233	257	241	383
193	313	311	439	433	359	163	367	113	401	263
97	89	449	617	479	103	281	31	557	521	131
79	599	191	101	11	571	17	563	647	547	29
601	5	677	7	577	13	641	109	41	23	661

Fig. 13.

series was arranged in magic formation by Mr. J. N. Muncey, and his square showing the lowest possible summation (3355) is given in Fig. 13.

SQUARE OF THE TWELFTH ORDER.

The sum of the first 144 prime numbers 1 to 827 inclusive, is 54168, the twelfth part of which is 4514. It is worthy of note that this is the only *straight series* of prime numbers of all that have been hitherto considered which is evenly divisible by n, and which is also capable of magic arrangement. Mr. J. N. Muncey has made a magic square of this series, which is shown in Fig. 14.

1	823	821	809	811	797	19	29	313	31	23	37
89	83	211	79	641	631	619	709	617	53	43	739
97	227	103	107	193	557	719	727	607	139	757	281
223	653	499	197	109	113	563	479	173	761	587	157
367	379	521	383	241	467	257	263	269	167	601	539
349	359	353	647	389	331	317	311	409	307	293	449
503	523	233	337	547	397	421	17	401	271	431	433
229	491	373	487	461	251	443	463	137	439	457	283
509	199	73	541	347	191	181	569	577	571	163	593
661	101	643	239	691	701	127	131	179	613	277	151
659	673	677	683	71	67	61	47	59	743	733	41
827	3	7	5	13	11	787	769	773	419	149	751

Fig. 14.

SUMMARY.

ORDER OF SQUARE	TOTALS OF SERIES	LOWEST SUMMATIONS	SQUARES MADE BY
3d	333	111	Henry E. Dudeney (1900)
4th	408	102	Ernest Bergholt and C. D. Shuldham
5th	1065	213	H. A. Sayles
6th	2448	408	C. D. Shuldham, J. N. Muncey
7th	4893	699	" "
8th	8912	1114	" "
9th	15129	1681	" "
10th	24160	2416	J. N. Muncey
11th	36905	3355	"
12th	54168	4514	"

W. S. ANDREWS.
H. A. SAYLES.

SCHENECTADY, N. Y.

GEOMETRIC MAGIC SQUARES AND CUBES.

The term "geometric" has been applied to that class of magic squares wherein the numbers in the different rows, columns, and diagonals being multiplied together give similar products. They are analogous in all respects to arithmetical magic squares.

Any feature produced in an arithmetical square can likewise be produced in a geometric square, the only difference being that the features of the former are shown by summations while those of the latter are shown by products. Where we use an arithmetical series for one, we use a geometric series for the other, and where one is constructed by a method of differences the other is constructed by ratios.

These geometric squares may be considered unattractive because of the large numbers involved, but they are interesting to study, even though the actual squares are not constructed. The absurdity of constructing large geometric squares can be easily shown. For example, suppose we were to construct an 8th order square using the series 2^0, 2^1, 2^2, 2^3,.... 2^{63}, the lowest number would be 1 and the highest number would be 9,223,372,036,854,775,808. Who would be willing to test the accuracy of such a square by multiplying together the numbers in any of its rows or columns?

Analogous to the arithmetical squares the geometric squares may be constructed with a straight geometric series, a broken geometric series, or a series which has no regular progression.

I have divided the methods of construction into four groups, namely: the "Exponential method," the "Exponential La Hirian method," the "Ratio method," and the "Factorial method."

THE EXPONENTIAL METHOD.

The most common way of constructing these squares is with a straight geometric series, arranged in the same order as a straight

7	0	5
2	4	6
3	8	1

Fig. 1.

2^7	2^0	2^5
2^2	2^4	2^6
2^3	2^8	2^1

Fig. 2.

128	1	32
4	16	64
8	256	2

$P = 4096$

Fig. 3.

arithmetical series would be in any summation square. This is equivalent to the following.

Form any magic with a straight arithmetical series as in Fig. 1.

Consider these numbers as exponents by repeating any number (in this case 2) before each of them, which will give us a square as shown in Fig. 2. It may be noticed that 2 is taken 12 times as a factor in each of the rows, columns, and diagonals, therefore forming a geometric square with constant products of 4096. The square transposed in natural numbers is shown in Fig. 3.

4	-3	2
-1	1	3
0	5	-2

Fig. 4.

3^{4}	3^{-3}	3^{2}
3^{-1}	3^{1}	3^{3}
3^{0}	3^{5}	3^{-2}

Fig. 5.

81	$\frac{1}{27}$	9
$\frac{1}{3}$	3	27
1	243	$\frac{1}{3}$

P = 27

Fig. 6.

$3\frac{1}{2}$	0	$2\frac{1}{2}$
1	2	3
$1\frac{1}{2}$	4	$\frac{1}{2}$

Fig. 7.

$4^{\frac{7}{2}}$	4^{0}	$4^{\frac{5}{2}}$
4^{1}	4^{2}	4^{3}
$4^{\frac{3}{2}}$	4^{4}	$4^{\frac{1}{2}}$

Fig. 8.

128	1	32
4	16	64
8	256	2

P = 4096

Fig. 9.

Figs. 4, 5, and 6 show the same process involving negative exponents.

Figs. 7, 8 and 9 show how fractional exponents may be used: and the use of both fractional and negative exponents is shown in Figs. 10, 11 and 12.

$2\frac{1}{2}$	-1	$1\frac{1}{2}$
0	1	2
$\frac{1}{2}$	3	$-\frac{1}{2}$

Fig. 10.

$3^{\frac{5}{2}}$	3^{-1}	$3^{\frac{3}{2}}$
3^{0}	3^{1}	3^{2}
$3^{\frac{1}{2}}$	3^{3}	$3^{-\frac{1}{2}}$

Fig. 11.

$\sqrt{243}$	$\frac{1}{3}$	$\sqrt{27}$
1	3	9
$\sqrt{3}$	27	$\sqrt{\frac{1}{3}}$

P = 27

Fig. 12.

2^{-5}	2^{3}	2^{8}	2^{-2}
2^{6}	2^{0}	2^{1}	2^{3}
2^{2}	2^{4}	2^{5}	2^{-1}
2^{7}	2^{-3}	2^{-4}	2^{10}

Fig. 13.

$\frac{1}{32}$	512	256	$\frac{1}{4}$
64	1	2	8
4	16	32	$\frac{1}{2}$
128	$\frac{1}{8}$	$\frac{1}{16}$	1024

P = 1024

Fig. 14.

Figs. 13 and 14 show the exponential method applied to a fourth order square. The exponents in Fig. 13 taken alone, obviously form an arithmetical magic.

This square is an associated square,[1] with the products of each complementary pair equaling 32.

THE EXPONENTIAL LA HIRIAN METHOD.

Two primary squares are shown in Figs. 15 and 16. One is filled with the powers 0, 1 and 2 of the factor 2, and the other with the powers 0, 1 and 2 of the factor 5. Each primary square in itself

2^0	2^2	2^1
2^2	2^1	2^0
2^1	2^0	2^2

Fig. 15.

5^1	5^2	5^0
5^0	5^1	5^2
5^2	5^0	5^1

Fig. 16.

P = 1000

5	100	2
4	10	25
50	1	20

Fig. 17.

is a geometric magic with triplicate numbers. Figs. 15 and 16 multiplied together, cell by cell, will produce the magic shown in Fig. 17.

The factor numbers in this case, 2 and 5, are not necessarily different, but when they are alike the exponents must suit the condition, to avoid duplicate numbers in the final square. To make this clearer: if we form two primary squares that will add together and

3^0	3^1	3^2	3^3
3^3	3^2	3^1	3^0
3^1	3^0	3^3	3^2
3^2	3^3	3^0	3^1

Fig. 18.

2^0	2^4	2^2	2^4
2^2	2^4	2^0	2^6
2^4	2^2	2^6	2^0
2^6	2^0	2^4	2^2

Fig. 19.

P = 514944

1	192	36	432
108	144	3	64
48	4	1728	9
596	27	16	12

Fig. 20.

form an arithmetical magic, the same factor number may be added to each of these primary squares, using the former numbers as exponents, and the two will become geometric primary squares that will multiply together and form a geometric magic without duplicate numbers.

Figs. 18, 19 and 20 show the same method applied to the fourth

[1] A square is associated when any two numbers opposite to and equidistant from the center of the square, give a constant product in geometric squares, or a constant sum in arithmetical squares. Such pairs are called complementaries.

order squares. This is a Jaina square, and is
diagonal and also contains the other Jaina featu
Figs. 21, 22, 23 show the application of a do

3^0	5^1	5^2	3^1
3^1	5^2	5^1	3^0
5^1	3^0	3^1	5^2
5^2	3^1	3^0	5^1

Fig. 21.

2^1	2^0	2^2	7^1
2^2	7^1	2^1	2^0
7^1	2^2	2^0	2^1
2^0	2^1	7^1	2^2

Fig. 22.

to the primary squares. The constants of Fig. 2
those of Fig. 22 are $2^3 \times 7$. This is also a Jaina

THE RATIO METHOD.

If we fill a square with numbers as in Fig.
ratios between all horizontally adjacent cells ar
ratios between all vertically adjacent cells are
natural square which can be formed into a geome
of the well-known methods.

The horizontal ratios in Fig. 24 are 2 as r
figure at the end of the division line, and the ve

	2	2	
3	1	2	4
3	3	6	12
	9	18	36

Fig. 24.

18	1	12
4	6	9
3	36	2

Fig. 25.

as indicated, and Fig. 25 shows the magic arr
series.

In a fourth order square, as in Fig. 26, the
are not necessarily equal, and neither are the v
magic may be made from this natural square by
bers in the upper row into a primary square as
numbers in the left-hand column are then formed

[3] See reference to the Jaina Square in *Magic Squares*
Andrews.

mary square as in Fig. 28. These two primary squares will then produce the magic shown in Fig. 29.

P = 7560

1	2	3	9
4	8	12	36
5	10	15	45
7	14	21	63

Fig. 26.

1	2	3	9
9	3	2	1
2	1	9	3
3	9	1	2

Fig. 27.

1	7	4	5
4	5	1	7
5	4	7	1
7	1	5	4

Fig. 28.

1	14	12	45
36	15	2	7
10	4	63	3
21	9	5	8

Fig. 29.

Fig. 30 is a balanced natural square. This series will produce a perfect Jaina, a Nasik,[3] or an associated square. Figs. 31, 32 and 33 show it arranged in a Nasik formation.

P = 14400

1	2	5	10
3	6	15	30
4	8	20	40
12	24	60	120

Fig. 30.

1	2	10	5
10	5	1	2
1	2	10	5
10	5	1	2

Fig. 31.

1	12	1	12
3	4	3	4
12	1	12	1
4	3	4	3

Fig. 32.

1	24	10	60
30	20	3	8
12	2	120	5
40	15	4	6

Fig. 33.

Mr. L. S. Frierson's arithmetical equation squares also have their geometric brothers. Where he applies the equation $a - b = c - d$, we use the proportion $a : b :: c : d$. Fig. 35 shows a natural

	A	B	
C	F	E	C
D	E	F	D
	A	B	

Fig. 34.

2	3	4	6
1	7	8	56
28	21	12	9
14	49	24	84

Fig. 35.

84	3	4	14
1	12	21	56
28	8	7	9
6	49	24	2

Fig. 36.

P = 14112

equation square, and besides the proportions there shown, the diagonals of the magic depend on the necessary proportion $a : b :: c : d$ as indicated in the respective cells of Fig. 36*a*.

The magic is then formed by revolving the diagonals 180° as is shown in Fig. 36, or by interchanging the numbers represented by like letters in Fig. 34.

Another form of natural equation square is shown in Fig. 38.

[3] A concise description of Nasik Squares is given in *Enc. Brit.*

The diagonals in this square depend on the equation $a \times b =$ (see Fig. 36*b*). The magic is made by interchanging the n

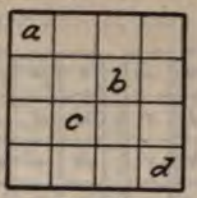


Fig. 36*a*.

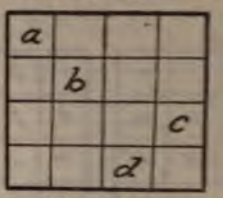


Fig. 36*b*.

represented by like letters in Fig. 37, producing Fig. 39 ar adjusting to bring the numbers represented by the A's and

P =

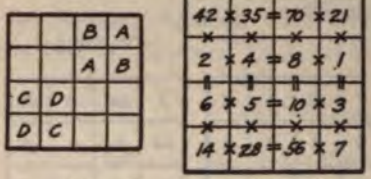


Fig. 37. Fig. 38. Fig. 39. Fig. 40.

Fig. 37, in one diagonal and the numbers represented by and C's in the other diagonal, or in other words, shifting th hand column of Fig. 39 so as to make it the right-hand c

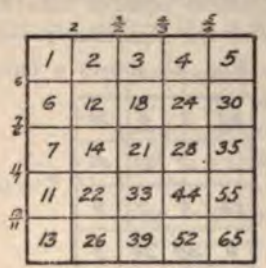


Fig. 41.

P = 720720

Fig. 42.

Fig. 43.

Fig. 44.

and then shifting the bottom line of the square thus formed to the top. The result of these changes is shown in Fig. 40.

Fig. 41 is a fifth order natural square, and Figs. 42, 43 and 44 clearly show the method of forming the magic, which is pan-diagonal.

In the same manner Dr. Planck constructed his arithmetical Nasik squares[4] of orders $4m + 2$, we can likewise construct geometric squares.

Fig. 45 shows a natural 7×7 square with the central row and column cast out. This is formed by path method into the Nasik

$P > 22 \times 10^{42}$

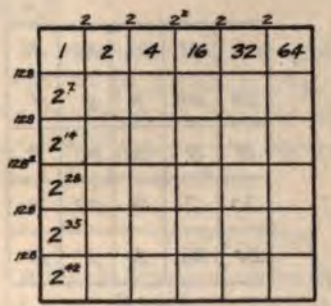


Fig. 45.

Fig. 46.

square, rearranging the columns in this order 1, 4, 32, 64, 16, 2 and the rows in this order 1, 2^7, 2^{28}, 2^{42}, 2^{35}, 2^{14} and using advance move 2, 3 and a break move $-1, -1$.

THE FACTORIAL METHOD.

In this method we fill two primary squares, each with n sets of any n different numbers, such that each row, column, and diagonal contains each of the n different numbers.

To avoid duplicates in the magic, the primary squares should have only one number in common, or they may not have any number in common. Also, no two numbers in one primary square should have the same ratio as two numbers in the other primary square.

This may be more clearly explained by an example. Suppose we select two sets of numbers as follows for constructing a fourth order square.

1 2 4 7
1 3 5 6

Four sets of the upper row of numbers are to fill one primary

[4] See article by Messrs. Andrews and Frierson in *The Monist*, Vol. XXII, No. 2.

square and four sets of the lower row are to
two groups contain only one number in cor
would contain duplicate numbers due to the d
3:6. Therefore $2 \times 6 = 4 \times 3$, consequently
would be 12. But if we interchange the numb
will be corrected and the square can then be
duplicate numbers.

The square in Fig. 47 is constructed with

1 2 3 4
1 5 6 7

P = 5040

1	15	24	14
12	28	3	5
21	6	10	4
20	2	7	18

Fig. 47.

1	10
28	48
18	3
30	7
24	36

F

A fifth order square is shown in Fig. 48
following groups are used:

1 2 3 4 6
1 5 7 8 9

This square is pan-diagonally magic.

I will now show how a Nasik sixth order
by a method derived from Dr. Planck's me
Nasik squares with arithmetical series.

Fill two six-celled rectangles, each with s
the two rectangles to have no more than one

1	32	16
64	2	4

Fig. 49.

1	243	81
729	3	9

Fig. 50

The numbers in each rectangle should be a
products of its horizontal rows are equal, and
vertical rows are equal.

Two of such sets of numbers that will suit the above conditions will not be found so readily as in Dr. Planck's examples above mentioned.

The two sets forming the magic rectangles in Figs. 49 and 50 are taken from the following groups:

2^0 2^1 2^2 2^3 2^4 2^5 2^6

3^0 3^1 3^2 3^3 3^4 3^5 3^6

Each group is a geometrical series of seven numbers, and in forming the rectangle, the central number in each group is omitted.

The rectangles are arranged in primary squares as shown in Fig. 51, and the two rectangles in Figs. 49 and 50 so arranged will produce the square in Fig. 52. This square is pandiagonal, 2^2-ply and 3^2-ply.[5]

P = 101,559,956,668,416.

729	192	9	44656	3	576
32	486	2592	2	7776	162
11664	12	144	2916	48	36
1	15552	81	64	243	5184
23328	6	288	1458	96	18
16	972	1296	4	3888	324

Fig. 52.

GEOMETRIC MAGIC CUBES.

I will here briefly describe the analogy between the series which may be used in constructing cubes, and those used in constructing squares.

It is obvious that an unbroken geometric series of any sort may be arranged in a cube of any order, by placing the numbers in the cube in the same progression as the numbers of an arithmetical series would be placed in forming an arithmetical cube. This may be accomplished by an extension of the method exemplified in Figs. 1 to 14 inclusive.

1	2	4	3	6	12	9	18	36
5	10	20	15	30	60	45	90	180
25	50	100	75	150	300	225	450	900

Fig. 53.

In using the Exponential La Hirian method, the same process is followed in cubes as in squares, the main difference being that three primary cubes are necessarily used.

Fig. 53 shows a natural cubic series, obtained by the Ratio

[5] A square is said to be m^2-ply when the numbers in any m^2 group of contiguous cells give a constant product in geometric squares, or a constant sum in arithmetical squares.

method. The three squares represent the three planes of the cube The numbers 5 at the left of the first square represent the ratio between vertically adjacent cells in each of the planes. The numbers 2 above represent the ratio between horizontally adjacent cells in each of the planes, and the numbers 3 between the squares represent the ratio between adjacent cells from plane to plane.

By rearranging this series into a cube according to the path methods as in arithmetical cubes,[6] many results may be obtained one of which is shown in Fig. 54.

A fourth order balanced or associated series is shown in Fig 55. This series is analogous to the plane series in Fig. 30, and may

1	90	300
60	25	18
450	12	5

150	4	45
9	30	100
20	225	6

180	75	2
50	36	15
3	10	900

P = 27000

Fig. 54.

be transformed into a magic cube by the following well-known method:

1	2	5	10
3	6	15	30
4	8	20	40
12	24	60	120

7	14	35	70
21	42	105	210
28	56	140	280
84	168	420	840

9	18	45	90
27	54	135	270
36	72	180	360
108	216	540	1080

63	126	315	630
189	378	945	1890
252	504	1260	2520
756	1512	3780	7560

Fig. 55.

Interchange the numbers in all associated pairs of cells which are inclosed in circles, producing the result shown in Fig. 56.

P = 57,153,600

7560	2	5	756
3	1260	504	30
4	945	378	40
630	24	60	63

7	540	216	70
360	42	105	36
270	56	140	27
84	45	18	840

9	420	168	90
280	54	135	28
210	72	180	21
108	35	14	1080

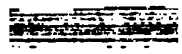
120	126	315	12
189	20	8	1890
252	15	6	2520
10	1512	3780	1

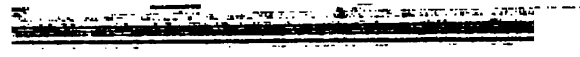
Fig. 56.

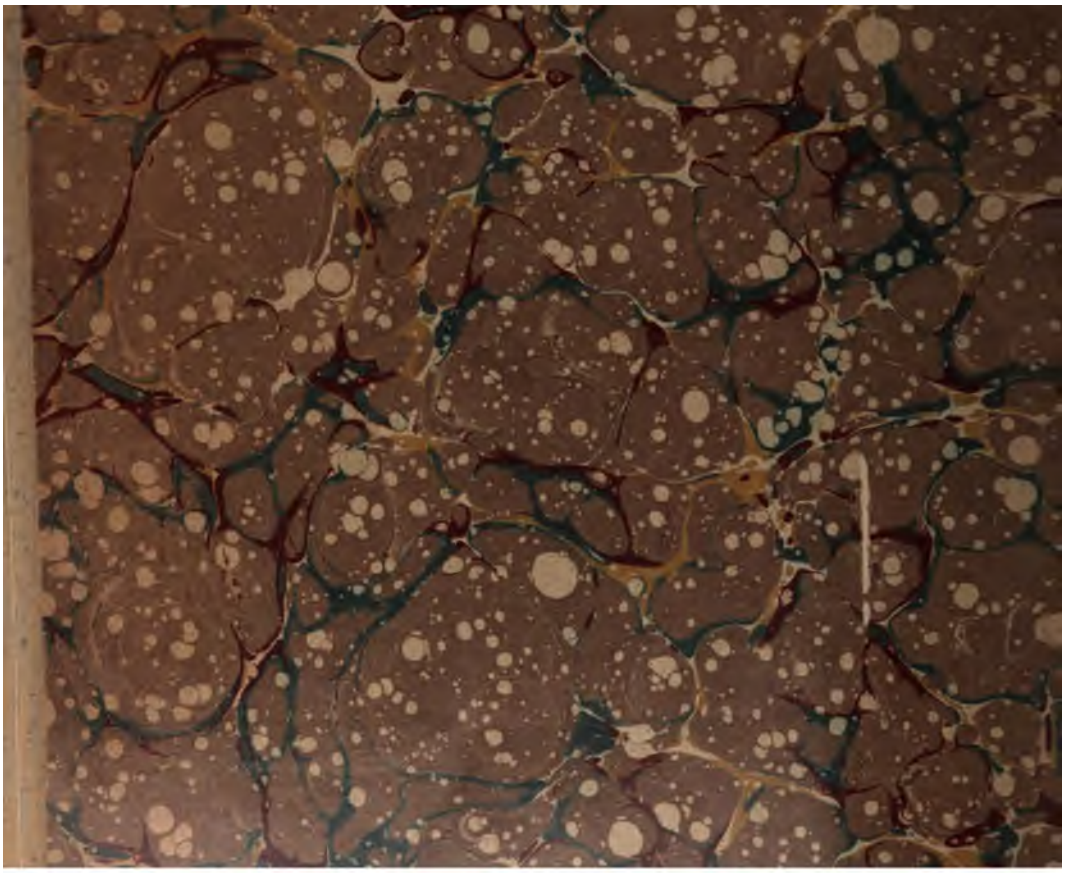
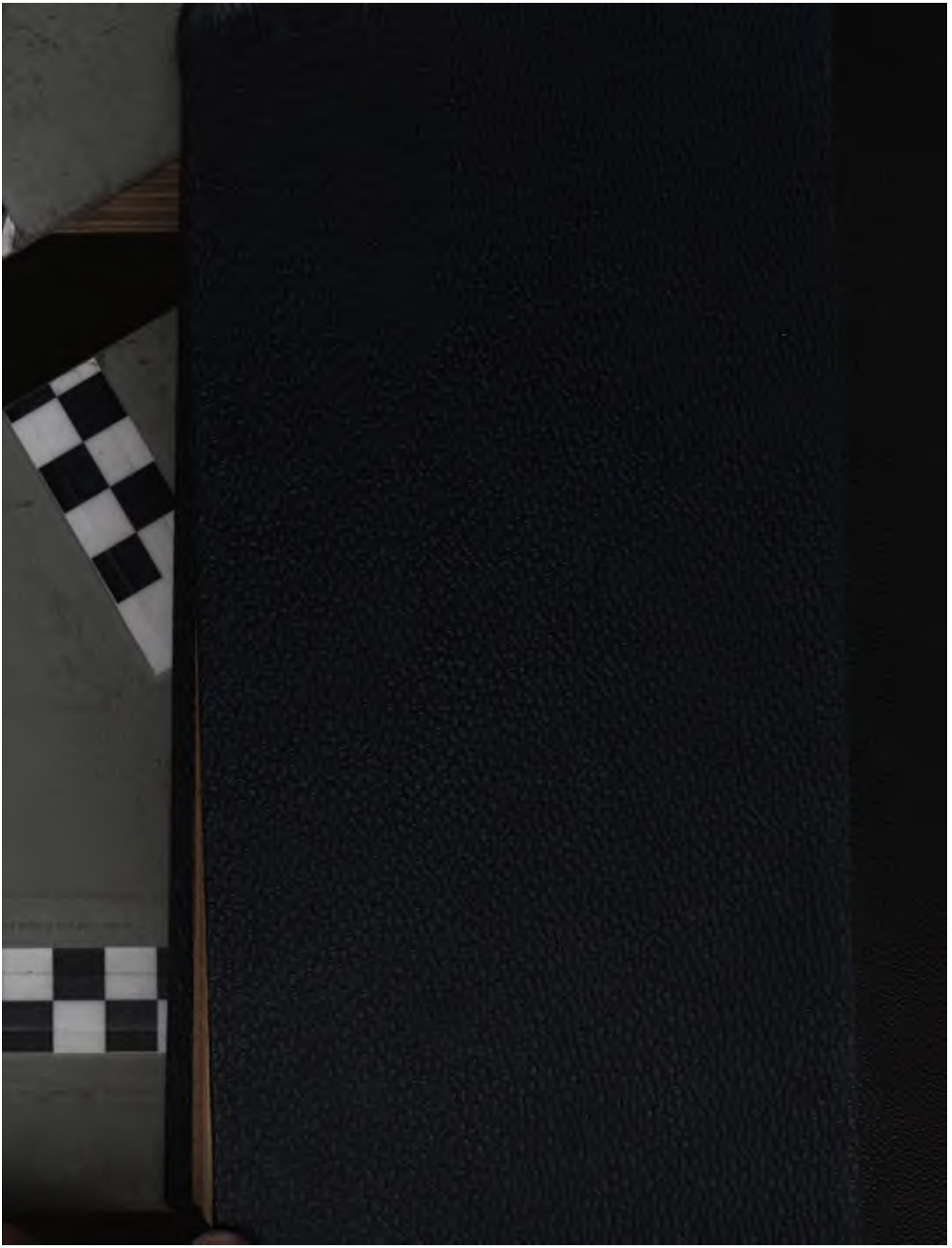
The possibilities in using the Factorial method in constructing cubes, has not been investigated by the writer.

SCHENECTADY, N. Y. HARRY A. SAYLES.

[6] See *Magic Squares and Cubes* by W. S. Andrews.







ANNEX